Autism and Child Psychopathology Series
Series Editor: Johnny L. Matson

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Handbook of Applied Behavior Analysis for Children with Autism

Clinical Guide to Assessment and Treatment

Springer

Autism and Child Psychopathology Series

Series Editor

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Brief Overview
The purpose of this series is to advance knowledge in the broad multidisciplinary fields of autism and various forms of psychopathology (e.g., anxiety and depression). Volumes synthesize research on a range of rapidly expanding topics on assessment, treatment, and etiology.

Description
The **Autism and Child Psychopathology Series** explores a wide range of research and professional methods, procedures, and theories used to enhance positive development and outcomes across the lifespan. Developments in education, medicine, psychology, and applied behavior analysis as well as child and adolescent development across home, school, hospital, and community settings are the focus of this series. Series volumes are both authored and edited, and they provide critical reviews of evidence-based methods. As such, these books serve as a critical reference source for researchers and professionals who deal with developmental disorders and disabilities, most notably autism, intellectual disabilities, challenging behaviors, anxiety, depression, ADHD, developmental coordination disorder, communication disorders, and other common childhood problems. The series addresses important mental health and development difficulties that children and youth, their caregivers, and the professionals who treat them must face. Each volume in the series provides an analysis of methods and procedures that may assist in effectively treating these developmental problems.

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Preface

This is the first edition on one of the most popular topics in autism, early intervention. Numerous state and independent providers worldwide have developed and implemented these programs. Methods with by far the best evidence are those based on applied behavior analysis. This is the most comprehensive book on the topic for doctoral and masters level professionals in the field as well as for graduate students. This book updates and expands on the earlier book. As such it should serve as a must have reference for people working or preparing to work in early autism programs. Professionals and students in clinical psychology, special education, school psychology, psychiatry, pediatricians, psychiatric nurses, neurology and social work will find the volume useful. The latest information on observations, assessment and treatment with specific strategies on implementation are covered.

Baton Rouge, LA, USA — Johnny L. Matson

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History and Overview of Applied Behavior Analysis

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Applied behavior analysis (ABA) is best known as an intervention for persons with autism and, currently, behavioral interventions are the most empirically supported intervention for this population. However, the field of behavior analysis, which has its roots in Skinner's radical behaviorism, includes the domains of basic and applied research as well as service delivery. Thus, to understand the origins of ABA, we must consider people whose work directly or indirectly facilitated the creation of the science of behavior analysis.

Early Influencers of Behavior Analysis

John B. Watson is often referred to as the "father of behaviorism" (Malone, 2014) and B. F. Skinner is known as the founder of behavior analysis, including radical behaviorism (Morris et al., 2005). However, other individuals, including Edward Thorndike and Ivan Pavlov, played a major role in the development of the systematic study of learning and behavior and are worth noting.

Edward Thorndike

One of the earliest influencers on the study of learning and behavior, and perhaps the "founder" of behaviorism (Malone, 2014), was Edward Thorndike. Thorndike was an American psychologist known for his work in animal learning. His dissertation, "Animal Intelligence" (1898), introduced what is known today as the Law of Effect and provides a framework for our understanding of both animal and human learning (Chance, 1999). In this paper, Thorndike (1898) describes an experiment in which he placed hungry animals (cats, dogs, and chickens) in enclosures (i.e., puzzle box) they could only escape by pulling at a loop of cord, pressing a lever, or stepping on a platform. Food was left outside of the enclosures, in view of the animal. A record was taken of the time the animal spent in the box prior to "succeeding" in emitting the necessary response to escape. This procedure was repeated until the animal acquired a "perfect association" between the response and escaping the box. Specifically, the association was deemed "perfect" when the escape response consistently occurred with a short latency between being placed in the enclosure and escaping the enclosure. If the animal did not "succeed" in escaping the enclosure within an unspecified amount of time, the animal was removed from the enclosure, was not given access to food, and the trial was recorded as a "failure." Overall, Thorndike found repeated exposure led to a decrease in latency to escape. These data were graphed and yielded a "time-curve" that captured one of the first demonstrations of a learning curve (see Figure 1 in Chance, 1999, for an example). Thorndike noted the responses that resulted in escape from the puzzle box and access to food were "stamped in," or more likely to occur again. Conversely, responses that did not result in escape from the box were "stamped out," or less likely to occur again. These learning processes have similarities to what we know now as reinforcement and punishment. In later experiments, Thorndike examined what we know now as generalization, discrimination, and observational learning procedures (Chance, 1999). Although Thorndike's description of stamping in and stamping out was incomplete (e.g., lacked considerations of antecedents and distinctions between positive and negative consequences), relative to current definitions of reinforcement and punishment, his work influenced further research in this area, and helped distinguish behaviorism from mentalism (Malone, 2014).

Ivan Pavlov

Another early influencer of the study of learning and behavior was Ivan Pavlov. Pavlov was a Russian physiologist known for his work on digestive glands (Clark, 2004); however, within the field of psychology and behavior analysis, he is best known for his serendipitous discovery in classical, or respondent, conditioning (Dewsbury, 1997). While studying the digestion of dogs, he noticed that the association between the presentation of the sound of a metronome and meat powder led the sound alone to elicit the dogs' salivation. This repeated pairing of the unconditioned stimulus (meat powder) and the neutral stimulus (metronome sound), and the resulting conditioned reflex was the start of research in respondent conditioning. Pavlov's experiments on respondent conditioning laid a foundation for much of the work by John. B. Watson (Gewirtz, 2001) as well as by B. F. Skinner (Catania & Laties, 1999).

John B. Watson

John B. Watson was an American psychologist who is often credited as the father of behaviorism for his contribution to the field of behavior analysis and psychology (Malone, 2014). Watson is best known for his 1920s experiment with Little Albert. In this study, Watson and his research assistant, Roasalie Wayner, conditioned the presence of a rat to elicit emotional responding (e.g., crying) of his infant subject, Albert, by pairing the presence of a rat with a loud noise (Watson & Rayner, 1920). Interestingly, the conditioning effects generalized to other animals and stimuli, including a rabbit. Along with this famous experiment, Watson provided one of the first introductions of behaviorism to the field of psychology. He was the first to argue for psychology to be considered a natural science (Malone, 2014), and he advocated for a new form of psychology in behaviorism in his 1913 paper "Psychology as the Behaviorist Views it." This paper was coined the "behavioral manifesto" (Moore, 2017) and emphasized how the environment affects behavior, as opposed to a "mental state" or what we refer to now as private events, or covert behavior, causing the observable (overt) behavior to occur. He provided a framework for methodological behaviorism, a form of behaviorism that excludes consciousness, feelings, and states of mind (Skinner, 1974) and instead focuses on observable events and behavior. In contrast to methodological behaviorism, radical behaviorism considers private or covert behavior to be similar to overt behavior in that both are occasioned by changes in the environment, executed at differing levels. B. F. Skinner introduced the philosophy of radical behaviorism and greatly contributed to the field of behavior analysis.

Skinner's Science of Behavior Analysis

Without a doubt, scientists and practitioners within behavioral sciences agree that Skinner profoundly impacted the conception of the science of behavior analysis and its application at the societal and individual levels. Regarding his contributions, Dews (1970; cited in Morris et al., 2005), mentioned that "massive advances of science" (p. 99) affect society in two different ways, the first one is by changing peoples' view of themselves, and the second is by leading to substantive changes in their environment. According to this author, Skinner's work has produced both kinds of effects. The notion of functional relations between behavior and environmental variables as a scientific explanation for human behavior opposed mainstream conceptions about its determinants and had the potential of altering humankind's perception of itself. Hence, the significant modifications in multiple societal practices (e.g., education, clinical services, social services) brought by Skinner's scientific views and the derived technologies definitely have changed society.

Additionally, Schlinger (2021) noted that "Skinner never hesitated to push boundaries and expand the applications of his discoveries and their theoretical and philosophical implications. As a result, Skinner was one of those rare individuals in history, especially in psychology, who contributed to basic science, theory, philosophy, and technology" (p. 2). Although quantifying Skinner's contribution to science and technology is an unfeasible task, Skinner is recognized as the most eminent psychologist of the twentieth century (Haggbloom et al., 2002). This recognition was based on quantitative indexes (e.g., number of citations of his work in textbooks and journal articles; Haggbloom et al., 2002, p. 142), as well as qualitative variables (e.g., memberships in the

National Academy of Science, the use of his name as an eponym; Haggbloom et al., 2002).

Brief Biographical Information

B. F. Skinner was born on March 20, 1904, in Susquehanna, a small town in Pennsylvania. According to the B. F. Skinner Foundation (n.d.), after attending Hamilton College and getting a bachelor's degree in English Literature (1926), his original professional plan was to become a writer. However, he came in contact with the work of Pavlov and Watson while working as a clerk in a bookstore and decided to pursue studies in psychology at Harvard University, where he was accepted as a doctoral student. His work during those years focused on studying the behavior of the "organism as a whole" under strictly controlled conditions to identify clear relations between the behavior and specific experimental conditions (B. F. Skinner Foundation, n.d.; Schlinger, 2021).

According to Schlinger (2021), the research Skinner conducted from late 1920s to late 1930s while at Harvard led to the discovery of operant learning laws, which he organized in a comprehensive theoretical framework in his first book, *The Behavior of the Organisms* (Skinner, 1938). In 1936, Skinner began an academic position at the University of Minnesota (Harvard University); subsequently, in 1945, he became the chair of the Psychology Department at Indiana University and, in 1948, he returned to Harvard as a professor (B. F. Skinner Foundation, n.d.; Harvard University, n.d.). During his time working at Harvard, Skinner taught courses and experimentally examined behavior, mostly using non-human animals as subjects; the educational materials he prepared for his undergraduate students, and the products of this research were published in books such as *Science and Human Behavior* (Skinner, 1953) and *Schedules of Reinforcement* (Ferster & Skinner, 1957). Skinner worked at Harvard until his retirement in 1974, but he remained actively engaged in the scientific community until a few days before his death on August 18, 1990.

Skinner's Contributions to Behavior Analysis

The fruit of Skinner's work, as evident by the nearly 291 published original articles and books (Smith & Morris, 2014), made the science of behavior analysis and its applications possible. Skinner's role in the development of what is known today as the science of behavior analysis can be organized in three main areas: (1) radical behaviorism (i.e., philosophy of science), (2) the new scientific field—Skinner's experimental analysis of behavior (EAB), and (3) applications of his science at the societal and the individual level. Although radical behaviorism and basic science are described in a sequential manner below, it is important to note that both developed concurrently. Specifically, as Skinner tested his ideas in his experiments with non-human animals, "these experiments served as the basis of the scientific field later called the experimental analysis of behavior. As the field developed over the years, a system of science developed with it" (Leigland, 2010, p. 207).

Radical Behaviorism

Moore (2011) indicated that initially psychology focused on studying "mental life" phenomena; for this subject matter, introspection was considered the appropriate method of study. Watson's behaviorism, introduced in the second decade of the twentieth century, presented an alternative to the prevailing vision in this science. However, Watson's stimulus-response (S-R) behaviorism was not without limitations; issues such as the "apparent spontaneity" and "variability" of behavior prompted the development of a different approach called mediational stimulus–organism–response (S-O-R) neobehaviorism (Moore, 2011). Neobehaviorism was represented by Edward C. Tolman and Clark L. Hull (Moore, 2010), and this approach incorporated organismic variables mediating stimulus–response relations to explain the behavioral phenomena (Moore, 2011). Tolman, known as the developer of "purposive behaviorism," proposed that variables such as environmental stimuli, physiological drive, heredity, previous training, and age did not affect behavior directly, but by influencing internal processes or intervening variables such as "cognitive maps" (Poling et al., 1990). Hull, on the other hand, organized a "complex and formal theoretical system" consisting of postulates (i.e., hypotheses) and corollaries (i.e., outcomes) that were presented in both verbal and mathematical forms to account for the role of "reducing needs" such us primary drives (e.g., hunger, sex) in the explanation of behavior (Poling et al., 1990, p. 10).

According to Schneider and Morris (1987), the term radical behaviorism was first used to refer to Watson's behaviorism, although in the present it is almost exclusively applied to Skinner's philosophy. Schneider and Morris affirmed that Skinner used the term for the first time in 1930 to refer to his views; however, this mention of the term occurred in an unpublished manuscript titled "A Sketch for an Epistemology" that he wrote as a postgraduate at Harvard. Later in 1945, in the article "The Operational Analysis of Psychological Terms," Skinner "first referred in print to his philosophy as "radical behaviorism" (Schneider & Morris, 1987, p. 33).

Skinner's philosophy, radical behaviorism, on the other hand, conceived behavior as a scientific subject matter by itself and in its own right (Moore, 2011). Moore's description of the basic principles of Skinner's radical behaviorism included that this subject matter is "formulated as a functional relation between the behavior in question and environmental variables" (p. 456). Similarly, Baum (2011) stated that the science of behavior is detached from any mentalistic explanations or any organismic variable. Thus, radical behaviorism is considered a step forward from Watson's behaviorism, in the sense that it also envisioned the science of behavior as a natural science, implying that all behavioral events, private and public, are natural events that can be explained in relation to other natural events (i.e., environmental stimuli preceding or following the behavior; Baum, 2011). From this point on, causal explanations could be stated in terms of functional relations between behavior and current and historical environmental events emphasizing selection by consequences, evolution, and nothing else.

From Skinner's radical behaviorism perspective, the importance of scientific knowledge is directly and proportionally related to its contribution to behavioral phenomena' prediction and control; in Moore's words, radical behaviorism pursues "increasing the understanding of what promotes effective action with respect to nature" (Moore, 2011, p. 459). Additionally, the importance of pragmatism in radical behaviorism has also been stated by Vargas (2017). According to this author, the principles of the science of behavior, as for any other science, will succeed based on their capacity to accurately predict and effectively affect behavioral phenomena occurring in various settings and situations.

Nevertheless, the word "radical" in radical behaviorism has been a topic of debate. Authors like Heward and Cooper (1992) and Moore (2011) have characterized the philosophy of radical behaviorism using words such as "complete," "thoroughgoing," and "comprehensive." The use of these words concerns this philosophy's commitment to accounting for all behavior, private (i.e., covert) and public (i.e., overt), as mentioned before, instead of restricting behaviorism's subject matter to public behavior. That is, in the case of radical behaviorism, the term "radical" refers to nothing else but the application of the same behavioral principles to both private and public events. Moreover, according to Moore (2011), behavioral principles developed based on public behavior can be used to interpret private forms of behavior. Further elaborations on this topic stated that "the boundary between public and private is continuously shifting" (Palmer, 2009, p. 12) and that observability itself could not be the basis for distinguishing between these two categories of behavior (Palmer, 2009).

Additional features of Skinner's radical behaviorism have been described. For instance, within Skinner's radical behaviorism, "analytic concepts" are defined in terms of their functions and its relations with the other elements in a contingency (e.g., a punisher is defined based on its effect upon a specific behavior; Moore, 2011), and concepts such as stimuli and responses are generic, that is, functional relations specify relations between stimuli classes and response classes instead of between single stimulus and response events (Baum, 2011; Moore, 2011). Additionally, radical behaviorism made it possible to bring verbal behavior under the scope of the new science of behavior by analyzing it as operant behavior, and therefore stripping verbal behavior from the conventional views about language that prevailed at that time (Baum, 2011). Finally, one of the basic principles of radical behaviorism was social activism (i.e., promoting practices that improve life quality of citizens; Moore, 2011). Although the philosophy of radical behaviorism originated in the work of B. F. Skinner, the work of our scientific community (e.g., researchers, scholars, practitioners) has led to its refinement and the continued advancement of this philosophy is endorsed (e.g., Heward & Cooper, 1992; Leigland, 2010).

Skinner's Experimental Analysis of Behavior

Skinner's experimental work at Harvard fostered the creation of the scientific field that he named as the experimental analysis of behavior (Cooper et al. 2020). In Schlinger's (2011) words, Skinner's earliest experimental research with rats was the origin of "new experimental discipline within psychology, which grew into a unified natural science, -behavior analysis-…" (p. 217). Thus, we can fairly say that our field started in the lab. More recently, the term experimental analysis of behavior (EAB) is used to refer to the basic domain (i.e., research intended to discover and clarify basic principles; Cooper et al., 2007) within behavior analysis; however, here the term is used to refer to Skinner's entire novel scientific system.

In 1966, Skinner described the distinguishing features of this new science of behavior in an article titled "What is the Experimental Analysis of Behavior?," which was organized according to the dependent variable, independent variables, treatment of relationships among these variables, and attitudes toward research. Regarding the dependent variable, and in accordance with his philosophical notion of the experimental analysis of behavior as a natural science, Skinner (1966) restated the importance of dealing with a natural datum, in this case, the frequency or rate of responding. He also highlighted the impact recording systems such as the cumulative record and correlated data analyses (i.e., changes in rate of responses and inter-response times distributions) had in separating the experimental analysis of behavior from traditional psychological approaches. Behavior explanations relied now on quantitative measurements of the phenomena rather than in mentalistic or physiological entities.

Additionally, in his discussions related to independent variables, Skinner (1966) argued that the main task of the experimental analysis of behavior is "to discover all the variables of which probability of response is a function" (p. 214). He advocated for describing stimuli using the language of physics (e.g., tone frequency, wavelength) instead of inferring any stimuli characteristic based on the behaver's or experimenter's behavior (e.g., the complexity of the task, "aversiveness"). Specifically, regarding variables traditionally associated with psychological terms like emotion or motivation, Skinner proposed that relevant independent variables consist of environmental events such as food deprivation and aversive and preaversive stimuli (i.e., stimuli that in the past preceded an aversive stimulus within a conditioned suppression arrangement) instead of inner states such as hunger, fear, or anxiety. Furthermore, in addition to the typical contingencies (e.g., extinction), other more complex contingencies involving various stimuli and responses interrelated were brought under study allowing the experimental analysis of behavior to account for behaviors that, in the past, were considered to be the result of cognitive processing (i.e., "applying rules").

Regarding relations among variables, accounting for changes in the rate of responding in real time was also identified by Skinner as a critical feature of the experimental analysis of behavior, a clear distinction from the standard practice in psychological research of recording data in "trial by trial" situations (Skinner, 1966). Likewise, Skinner (1966) described the importance of an inductive methodological approach that emphasizes experimental control of variables rather than later statistical analyses of the data since the experimental analysis of behavior is not designed to test hypotheses but to analyze relations between dependent and independent variables. Additionally, Skinner's science of behavior relied on the intensive observation (extended on time) of one or few organisms instead of statistically comparing single time measures of groups of individuals. And finally, in relation to the attitude toward research within the experimental analysis of behavior, Skinner advocated for a patient approach in dealing with the behavioral phenomena studied in our field; according to him, technical advances in science would make possible the identification of new behavioral phenomena.

Applications of Skinner's Science at the Societal and Individual Level

The applied science domain in behavior analysis is an integral part of what is known today as the field of behavior analysis, which also encompasses the philosophical underpinnings, basic science, and practice guided by behavior analysis (Cooper et al., 2007). Skinner's work led to the creation of the scientific field and its philosophy and his work significantly impacted the development of the applied branches, the science of applied behavior analysis and its practices (i.e., service delivery; Cooper et al., 2020). Additionally, although Skinner's research focused on the behavior of non-human animals, he stated that "the study of animals below the level of man is dictated mainly by convenience and safety. But the primary object of interest is always a man" (Skinner, 1956/ 1999b, p. 288). In fact, Skinner described many ways in which his science could be applied to socially relevant behavior, at both the society and individual levels, and his work influenced current practices in many ways.

Societal Level

According to De Melo et al. (2015), Skinner showed interest in solving significant human problems such as "overpopulation, nuclear war, pollution, equal rights and opportunities for women" (p. 39) and he argued that behavior technology could provide solutions to these problems. As a result, Skinner produced numerous written pieces on the value of extending behavioral analytical knowledge to cultural affairs for societal designing, including *Walden II* (1948), *Beyond Freedom and Dignity* (1971), and *Reflections on Behaviorism and Society* (1978).

Furthermore, Skinner's interest in societal issues led him to develop specific technologies such as the project pigeon, the air crib, and the teaching machine. Project pigeon, which began between 1940 and 1944 and has been considered "Skinner's first application of his science beyond his teaching research" (Morris et al., 2005, p. 106), entailed shaping pigeons' behavior to guide bombs to specific destinations. According to the B. F. Skinner Foundation, the birds were trained to peck ship-lookalike images that steered missiles toward the enemy's ship. The "air crib," created in 1945, consisted of a self-contained, sound-attenuating living space created to provide children's comfort, and it "served biological functions as much as behavioral ones" (Morris et al., 2005, p. 107). Finally, according to Rutherford (2017), Skinner's conviction about the operant principles' potential contribution to achieving academic success led him to create and to promote the manufacturing of teaching machines, devices that provided educational and immediate reinforcement for correct responses, and adjusted the pace of learning for each individual (Skinner, 1958). Skinner's work on the design of culture and society was conceptual in nature. Specifically, according to Rutherford (2017), beyond the technologies mentioned above, most of Skinner's contributions in this area consisted of his expressed commitment to "social applications of behavioral principles" and "embrace the project of redesigning the entire social order" (p. 292) by promoting the use of behavioral principles and derived technologies for the creation of a sustainable culture that evoke and reinforce prosocial behavior.

Finally, it is important to note that Skinner's philosophical assumptions and/or beliefs regarding determinisms vs. self-determination, cultural design as an engineering problem, the technological ideal of science, and his recommendation for a shift away from punishment-based approaches to some societal issues were not widely accepted by the public as they were seen as opposed to the mainstream American beliefs (Rutherford, 2017; Vargas, 2017). For instance, given that Americans valued the notion of personal freedom, American society reacted with skepticism to the idea of scientists and technocrats' role as cultural leaders/designers and with suspicion to the risk these ideas posed regarding a totalitarian approach in leading the societal and cultural changes including the risk of tyranny (Rutherford, 2017).

Individual Level

Although Skinner "never systematically integrated, advanced, or promoted applied behavior analysis" (Morris et al., 2005, p. 120), behavioral technologies derived from his behavioral principles undeniably have been successfully used to change the behavior of individuals. Moreover, Morris et al. (2005) concluded that Skinner did not have the role of founder or originator of applied behavior analysis; however, they affirmed that Skinner can be considered the father of the field of applied behavior analysis because its development was only possible given Skinner's science of behavior and its philosophy, and his commitment to seeking scientific solutions to socially significant behavioral issues.

According to Morris et al. (2005), in regard to the contribution of Skinner's work to the individual, Skinner's writings included topics such as interpretations of what the terms "typical" and "atypical" mean in the context of human behavior, description of potential areas for applications of his science of behavior (e.g., anxiety (Estes & Skinner, 1941/1999), verbal behavior (Skinner, 1957), behavioral pharmacology (Skinner & Heron, 1937), classroom management (Skinner, 1969/1999a)), and at least one experiment conducted with people on management of psychotic behavior (Skinner et al., 1954). In his 1956/1999 article, "What Is Psychotic Behavior," Skinner noted that atypical behavior (i.e., psychotic behavior) "is simply a part and parcel of human behavior" (p. 289). Therefore, the same variables theoretically and experimentally identified to occasion and control other behavior apply to behavior categorized as atypical; that is, atypical behavior can be considered as part of the subject matter of the natural science of behavior and labels such as typical and atypical are unnecessary within the experimental analysis of behavior.

Furthermore, Skinner's conceptualization of anxiety and his framework for the interpretation of verbal behavior are two examples of how his work greatly impacted current practice. In their article titled "Some Quantitative Properties of Anxiety" (1941/1999), Estes and Skinner noted that anxiety "has at least two defining characteristics: (1) it is an emotional state, somewhat resembling fear, and (2) the disturbing stimulus which is principally responsible does not precede or accompany the state but is "anticipated" in the future" (p. 484). Specifically, Estes and Skinner (1941/1999) studied conditioned suppression, an interaction of respondent and operant conditioning, using non-human participants (rats), and outcomes of that research served as an animal model for the interpretation of anxiety. In their experiment, Estes and Skinner repeatedly presented a shock following the presentation of a tone lasting three to five minutes. Although initial presentations of these stimuli did not result in any "disturbance" on behavior, after multiple tone–shock pairings the tone alone elicited an "anxiety" state that interrupted rats' rate of responding in an operant arrangement in which lever pressing was followed by food. The study also reported extinction and spontaneous recovery of the emotional state.

Moreover, in 1957 Skinner published his text, *Verbal Behavior*, which represented a major divergence to the previous interpretations of language-based "representational or logical processes" (Moore, 2011, p. 459). As previously mentioned, the conceptualization of verbal behavior as operant behavior made it possible to incorporate "language" as appropriate subject matter of the science of behavior. However, it is worth pointing out that Skinner's *Verbal Behavior* book is more "interpretation rather than experimental research" (Michael, 1984, p. 369) and that it likely did not play an important role in the creation of applied behavior analysis (Morris et al., 2005). Nevertheless, the book greatly impacted research and interventions for communication delays. For instance, Shillingsburg et al. (2021) described an intervention model for individuals with autism, developed based on Skinner's conceptualization of verbal behavior, which entails the use of various components (e.g., prioritization of mand training), many of which have empirical evidence. According to the authors, different terms have been used to refer to this model (e.g., applied verbal behavior, verbal behavior approach, verbal behavior intervention), and this model is widely used in applied settings.

Finally, Skinner's work with 15 individuals described as "catatonic psychotic patients" appears to be his only experimental study with humans (Skinner et al., 1954). During this study, which was a collaboration with Harry C. Solomon and Ogden R. Lindsey, for one hour daily, the patients were left alone in a room where they could operate the plunger of an apparatus resembling a vending machine; their responses resulted in access to candies, cigarettes, or pictures under a 1-min variable interval (VI) or a fixed ratio (FR) schedule of reinforcement. Skinner noted that the rate of response attained with the psychotic patients resembled those obtained in the laboratory with non-human animals; additionally, Skinner proposed that data obtained using these experimental arrangements could serve as baseline when evaluating other variables (e.g., drugs, the effects of discriminative stimulus, stimulus delta) and that these experiments could potentially be adapted to target socially significant responses. This work, which is translational (i.e., demonstrating the generality of reinforcers and the impact of schedules of reinforcement on human behavior) but also potentially applied (i.e., increased physical movement of catatonic patients), likely paved the way to the scientific analysis of problem behavior and its consequent prediction and control.

It is also worth noting that Skinner's work encompassed most of the seven dimensions of applied behavior analysis described by Baer et al. (1968). According to Morris et al. (2005), Skinner's methodological approach based on an "empirical epistemology" specifically addressed the behavioral, analytical, and technological dimensions because his approach implied reliable descriptions and measurements of behavior, accurate demonstration of functional relations between behavior and environment through reliable experimental control, and comprehensive descriptions of procedures, preparations, and materials. Furthermore, Morris et al. indicated that Skinner's "scientific content" referred to the basic principles of the science of behavior and therefore addressed the conceptually systematic dimension of applied behavior analysis. Moreover, the applied and effective dimensions are included in Skinner's *Walden II* book (1948), when Skinner discussed surveying community members on the effectiveness of and their satisfaction with the community practices (Morris et al., 2005). Finally, the generality dimension was not explicitly addressed in Skinner's work, but it was implicit in the development of teaching technologies (Morris et al., 2005).

Finally, as an active member of the scientific community, he also coexisted with those researchers considered pioneers and founders of applied behavior analysis. This coexistence lasted for at least three decades, from the emergency of applied behavior analysis in 1959 (Cooper et al., 2020) to Skinner's death in 1990. A long journey has taken the science of behavior analysis from the basic research lab to developing solutions for socially significant behavioral issues. In each step of this journey, Skinner's contributions can be identified.

Early Applied Studies

Research in applied behavior analysis set a foundation for how to apply the principles of behavior to problems of social significance. In 1968, the *Journal of Applied Behavior Analysis* (*JABA*) was founded and Baer et al.'s article titled "Some Current Dimensions of Applied Behavior Analysis" was published. In this seminal article, Baer and colleagues outlined what they envisioned for this applied subfield of behavior analysis and emphasized how it differed from its basic research counterpart. Specifically, basic research focused and still focuses on any behavior and any variables that may influence it. Applied research differs because it focuses on variables that are effective at improving a socially significant behavior. They advocated for the focus of the field and any studies included in *JABA* to be *applied* (i.e., behavior must be socially significant/important to humanity), *behavioral* (i.e., behavior must be observable and measurable to quantify change and progress), *analytic* (i.e., changes to intervention are data-based decisions), *technological* (i.e., interventions must be written clearly enough for another practitioner to replicate), *conceptually systematic* (i.e., interventions delivered to consumers are evidenced-based from the ABA literature), *effective* (i.e., interventions must produce meaningful change), and to include *generality* (i.e., behavior change should occur outside of intervention components, including across people and environments) (i.e., the seven dimensions of applied behavior analysis).

However, applied studies published prior to Baer et al. (1968) also helped inform the creation of the field both in general and in *JABA*. For example, according to Morris et al. (2013), possibly the earliest applied publication was the "Operant Conditioning of a Vegetative Human Organism," which demonstrated the effects of reinforcement on the arm movement of an 18-year-old male in a vegetative state (Fuller, 1949). In this study, the subject was deprived of food and warmth and sugar milk was delivered via syringe contingent on vertical arm and, later, head movements. The increase in movements was replicated across several sessions and provides the first demonstration of research conceptualizing the target behavior of a human as "operant" (Morris et al., 2013). Ultimately, however, this study was more translational in nature (Morris et al., 2013), as the behavior of focus was not socially significant. Subsequent studies would better meet the standards outlined in Baer et al.'s seminal article.

Interestingly, one of the first truly applied studies was published in the *Journal of Experimental Analysis of Behavior* (*JEAB*). In the article "The Psychiatric Nurse as a Behavioral Engineer," Ayllon and Michael (1959) describe how nurses working in a psychiatric institution implemented extinction and reinforcement procedures to decrease problematic behavior (e.g., psychotic talk) and increase appropriate behavior (e.g., independent feeding). This study is the first empirical demonstration of the principles of behavior being applied to solve socially significant problems and laid a foundation for what would later be called "applied behavior analysis" (ABA) (Sundberg & Schlinger, 2021).

A few years after "The Psychiatric Nurse as a Behavioral Engineer" was published, Ferster and DeMeyer (1961) published one of the first articles to include children with autism, referred by the authors as "autistic children." The authors taught two children with autism and two neurotypical children, referred to as "control subjects," to press a key in exchange for preferred edible and tangible stimuli, and later tokens that could be exchanged for those same stimuli. Results indicated the procedures were effective at increasing key presses and responding sustained across sessions. Although the target behavior of this study was not socially significant, this study demonstrated the effects of different schedules of reinforcement, emphasized the importance of reliability of data recording, and demonstrated the effectiveness of behavior-analytic procedures with children with autism. Ferster and DeMeyer's (1961) study was followed by research that showed ABA was a credible assessment and treatment technology for children with developmental disabilities by demonstrating how the principle of behavior could be used to produce changes in socially significant behavior.

One such example is Wolf et al.'s (1963) article, "Application of Operant Conditioning Procedures to the Behaviour Problems of an Autistic Child." Dicky, a three-and-a-half-year-old child diagnosed with autism, was admitted to a children's mental hospital because of tantrums involving self-injurious behavior (SIB), sleep problems, eating problems, refusal to wear glasses, and delayed social and verbal repertoires. The authors described manipulating antecedents (e.g., food deprivation) and consequences (e.g., food delivery) for the target behaviors in a similar manner as done in procedures previously used in basic research (e.g., shaping, positive reinforcement, and extinction). Using these procedures, the authors were able to successfully decrease tantrums and bedtime problems and increase Dicky's verbal and social skills and the amount of time he wore his glasses. Furthermore, treatment effects persisted and generalized to the home setting, and additional skills were taught in Dicky's preschool setting (Wolf et al., 1967). Moreover, Wolf et al. (1967) reported that after 3 years of the intensive behavior modification procedures, Dicky had gone from "hopeless" to attending public school. These two studies demonstrated the effectiveness of early applied research aimed at decreasing problem behavior and increasing appropriate behavior in individuals with developmental disabilities, and promoted further research in this area.

Other noteworthy articles that have had substantial influence on the field of behavior analysis, specifically relating to assessment and treatment of problem behavior, include Carr (1977) and Iwata et al. (1982/1994). Carr (1977) consisted of a review on hypotheses of operant variables that influence self-injurious behavior, including social positive, social negative, sensory stimulation, aberrant physiological processes, and attempts to establish "ego boundaries" or "guilt." Although not an empirical study, the review offers insight into possible functions of problem behavior, some that were later assessed in what is considered to be the gold standard for assessment of problem behavior (Schlinger & Normand, 2013). Iwata et al.'s (1982/1994) study, "Toward a Functional Analysis of Self-Injury," outlined methodology for assessment of problem behavior (Schlinger & Normand, 2013). This initial/original functional analysis methodology included three tests and one control condition that were rapidly alternated in a multielement experimental design. Test conditions were designed to determine if specific environmental conditions evoked problem behavior and included the social disapproval, academic demand, and alone conditions. Specifically, test conditions were designed to identify the contingencies controlling self-injurious behavior (SIB). The test conditions were compared to a control condition, instructed play, that was arranged to decrease the likelihood of SIB. The development of these conditions was intended to determine if SIB was maintained by positive reinforcement (contingent attention), negative reinforcement (escape or avoidance of demands), or automatic reinforcement (e.g., sensory stimulation). A function of SIB was identified for six of the nine subjects, and the authors noted that while the focus of the study was on assessment of problem behavior, all subjects received intervention services with subsequent treatment analyses. Furthermore, they reported the preliminary intervention results were "encouraging" for subjects whose functional analysis produced differentiated responding. This functional assessment and variations of it are readily used and studied today to identify the function of problem behavior and subsequently develop effective function-based interventions.

Clinical Applications of ABA

As previously indicated, ABA is known as a treatment for persons with autism and behavioral treatments have been shown to be more effective than other interventions. However, ABA has also been shown to be effective with other populations. Next, we provide a brief overview of autism, commonly used treatment models and focused practices, and examples of studies using behavioral interventions to improve socially relevant behaviors of persons that do not have autism.

Etiology and History of Autism

According to the Centers for Disease Control and Prevention (CDC, 2021), approximately 1 in 54 children has autism spectrum disorder (ASD), a drastic increase since 2000 when it was estimated that the prevalence was 1 in 150 children. ASD impacts children independent of their race, ethnicity, and socioeconomic status; however, autism is much more common in boys than girls. Furthermore, approximately 33% of individuals with autism have an intellectual disability (CDC, 2021) and many have other comorbidities such as attention deficit hyperactivity disorder (ADHD) and epilepsy (Mannion & Leader, 2013).

Leo Kanner, a child psychiatrist from Ukraine, is often credited to be the first person to use the term "autism" in reference to what is currently known as autism spectrum disorder. In his seminal paper, "Autistic Disturbances of Affective Contact" (1943), Kanner described 11 children who, although different in some ways, had several behavioral characteristics in common, including "inability to relate themselves" to the environment around them, early onset of "autistic aloneness," "delayed echolalia," and "excellent rote memory." Prior to this work, the term "autism" was used by Eugen Bleuler in reference to the social withdrawal displayed by persons with schizophrenia (Barahona-Corrêa & Filipe, 2016). Of the cases described by Kanner, the first and likely the most well known of them is Donald Tripplett, who was evaluated in 1938 at the age of 5 years. However, it is important to note that around the same time Hans Asperger, an Austrian physician, described another group of individuals as "autistic people." His work, which was mostly unknown until its translation to English in 1991, led to the previously used diagnostic criteria of Asperger's disorder (Barahona-Corrêa & Filipe, 2016).

Despite Kanner's publication in 1943, autism was not included in the *Diagnostic and Statistical Manual* (*DSM*) until its third edition was published in 1980 and throughout the years, the name and diagnostic criteria for autism have evolved (Rosen et al., 2021). In the *DSM-III* the terms "infantile autism" and "residual infantile autism" were employed and autism was included in the class of Pervasive Developmental Disorders (PDDs), but the name was changed to "autistic disorder" in the 1987 revision of the *DSM* (*DSM-III-R*). Then, when the *DSM-IV* was published, autistic disorder and Asperger's disorder were considered two distinguished disorders that overlapped in many aspects but differed from one another in regard to cognitive and language skills (see American Psychiatric Association, 1994). Currently, the term autism spectrum disorder (ASD) is employed, and refers to a neurodevelopmental disorder characterized by deficits in social, communication, and interaction, as well as the presence of restricted and repetitive behaviors and Asperger's disorder is no longer a separate diagnosis (APA, 2013). Given that the term autism is commonly used, from hereafter we use terms "autism" and "autism spectrum disorders" interchangeably. Although the exact cause of ASD is yet to be identified, it is believed that ASD may have multiple genetic and environmental causes and the child's sex, family history of ASD or other disorders, pre-term birth, and age of parents have been recognized as risk factors for an ASD diagnosis (Mayo Clinic, n.d.; Healthline, 2021). More importantly, research has proven that ASD is not caused by vaccines such as the measles-mumps-rubella immunization (MMR; Institute of Medicine (US) Immunization Safety Review Committee, 2004).

Types of Treatments for Autism

A web search results in an array of interventions for autism; however, it is important to note that some interventions currently marketed as treatments or cures for autism lack scientific evidence or have been shown to have no empirical support. Examples of interventions lacking scientific support include anti-fungal treatments, facilitated communication, intravenous gamma globulin, and sensory integration therapy (Association for Science in Autism Treatment (ASAT), n.d.). Additionally, chelation, which entails removing heavy metals from the body, has been found to cause harm to some individuals (Hofer et al., 2017). Although no medication can cure autism, some medications such as risperidone and aripiprazole can treat symptoms of autism (National Institutes of Health (NIH), 2021a). Furthermore, in comparison studies, behavioral treatment has been shown to be more effective than other interventions (e.g., "eclectic" treatments; Eikeseth et al., 2007; Howard et al., 2005). Findings of previous research have indicated early intervention is beneficial for individuals with ASD (e.g., Landa, 2018; Lovaas, 1987; McEachin et al., 1993; Virués-Ortega, 2010) and that it may result in better outcomes due to the increased brain plasticity that is present during a child's development (Dawson, 2008). Early intervention entails providing intervention at or prior to the child entering preschool (NIH, 2021b).

Behavioral Interventions for Autism

Behavioral interventions focus on the identification of environmental variables responsible for the acquisition and maintenance of behavior, include frequent measurement of behavior to evaluate progress, and employ procedures that are based on principles of behavior analysis and supported by research (LeBlanc & Gillis, 2012). Behavioral intervention (i.e., applied behavior analysis or ABA) has been identified as well-established and efficacious for persons with autism (e.g., Eldevik et al., 2009; Rogers & Vismara, 2008) and include two main classes of interventions, comprehensive treatment models (CTMs) (Odom et al., 2010a) and focused intervention practices (Odom et al., 2010b). Accordingly, comprehensive treatment models (CTMs) are structured treatment programs that are implemented for an extended period (e.g., 25 hours a week for a year), include interventions targeting multiple domains (e.g., cognitive functions, social skills, and adaptive behaviors), and include multiple treatment components to address core features of autism, whereas focused intervention practices are designed to impact a single behavior or skills of an individual with autism (Odom et al., 2010b). Thus, CTMs include a variety of focused intervention practices. Examples of CTMs include the University of California, Los Angeles (UCLA) Young Autism Program (YAP), the Treatment and Education of Autistic and Communication Handicapped Children (TEACCH) program, the Denver/Early Start Denver model (ESDM) (Eikeseth, 2009; National Research Council, 2001), and Early Intensive Behavioral Intervention (EIBI); however, it is important to note that the TEACCH and ESDM treatment models do not emphasize the principles of behavior analysis. Discrete trial teaching (DTT), functional communication training (FCT), and differential reinforcement are examples of focused intervention practices (Odom et al., 2010b).

Examples of Comprehensive Treatment Models (CTMs)

UCLA Young Autism Project

Directed by Ivar Lovaas, the YAP at the University of California, Los Angeles (UCLA) appears to be the first comprehensive treatment model for children with autism. It is often referred to as the Lovaas model of ABA. Originally it provided intensive, 40 hours per week of one-to-one individualized interventions to children with autism for a period of 2–3 years. At the start of intervention, therapy sessions occurred at the child's home and were provided in a DTT format. In the second year, incidental teaching was added, the children had opportunities to play with neurotypical peers, and they entered general educational preschools. These activities enhanced the children's social skills and facilitated adjustment to school. In the third and final year, the amount of therapy provided was decreased, allowing for greater inclusion into the classroom (see Lovaas, 1987; Smith et al., 2000). In addition to Lovaas (1987), numerous other researchers (e.g., Eikeseth et al., 2007; Sallows & Graupner, 2005; Smith et al., 2000) have evaluated the impact of intensive behavior therapy based on the Lovaas model and results indicated that many of the children receiving the therapy had substantial gains in various areas, including improved intelligent quotient (IQ) scores, communication, and adaptive behavior (see review by Reichow & Wolery, 2009). According to Lovaas (1987), 47% of the children who received intensive therapy achieved "recovery" (i.e., IQ increased to normal range and completion of first grade or placement in a regular education setting without assistance).

The TEACCH Program

The Treatment and Education of Autistic and Communication Handicapped Children (TEACCH) program is a structured teaching program (i.e., Structured Teaching) for individuals with autism designed based on common deficits and strengths of persons with autism, referred to as the "Culture of Autism." Examples of these characteristics include preference for visual information and routine, and impaired communication. As a result, Structured Teaching includes four essential mechanisms: arranging of the environment so it can be understood by the individual; use of visual supports to foster weaker skills; facilitating learning by using individual's special interests; and encouraging appropriate communication. The program is based at the University of North Carolina at Chapel Hill and it was started by Schopler in 1972 (see Marcus et al., 2000; Mesibov & Shea, 2010).

The Denver Model/Early Start Denver Model

The Early Start Denver Model (ESDM) is based on the Denver Model that originated in the 1980s with psychologists Sally Rogers and Geraldine Dawson at the University of Colorado Health Sciences Center, a day treatment program. In 1998 when the treatment unit closed, the intervention format was modified to be implemented in more natural settings such as the home and preschools, and it evolved into what is known today as the ESDM (National Research Council, 2001). The ESDM is designed for preschool-age children, 1–4 years old, and focuses on enhancing pivotal skills such as cognition, communication, play, and social skills through play, joint activities, and positive relationships. It is a manualized intervention that encompasses pivotal response training (PRT), a naturalistic approach to fostering language and social skills, and takes into account neurotypical learning and development. It includes one-to-one and group-based instruction, emphasizes caregiver involvement, and employs a relationship-focused curriculum that is flexible and can be implemented in many settings (see Dawson et al., 2010; Mesibov & Shea, 2010; Rogers, 2013; Virués-Ortega et al., 2010, 2013a, b).

Early Intensive Behavioral Intervention (EIBI)

It is a commonly used behavioral treatment for young children with autism, usually under the age of 5 years, based on the Lovaas' UCLA Young Autism Project. It is characterized by 20–40 hours of therapy per week that is individualized, based on outcomes of functional skills assessments, and delivered for an extended period of time (e.g., two or more years) and initially in a one-to-one format using discrete trial teaching (DTT) and incidental teaching. It addresses main skills deficits and excesses displayed by persons with autism, which include deficits in social and communication skills, play, and imitation, and the presence of restricted or repetitive behaviors. Furthermore, it includes caregiver training and caregiver involvement (see Howard et al., 2005; Peters-Scheffer et al., 2012; Reichow et al., 2012).

Examples of Focused Intervention Practices

During the recent years several comprehensive reviews of the literature have identified focused interventions meeting their specified criteria to qualify as an "established treatment" or as an evidence-based practice (e.g., Horner et al., 2005; Odom et al., 2010b; Steinbrenner et al., 2020). For instance, Steinbrenner et al. reviewed research published between 2012 and 2017 and, in combination with findings from a previous review of the literature from 1990 to 2021, identified 28 focused interventions meeting qualification as an evidence-based practice (i.e., at least two group design studies conducted by two or more different researchers or at least five single case design studies completed by at least three different investigators). Examples of these include DTT, functional communication training (FCT), and video modeling.

Research Support for Behavioral Interventions

Findings of previous research have shown comprehensive behavioral treatment models and focused behavioral interventions are effective for persons with autism (e.g., Eldevik et al., 2009; Steinbrenner et al., 2020). However, numerous variables have been identified as predictors of treatment outcomes. For instance, Eldevik et al. (2010) determined that gains in IQ and adaptive skills were greater for those receiving high treatment intensity (i.e., 36 or more hours per week). Similarly, Virués-Ortega et al. (2013a, b) determined that treatment duration, in addition to intensity (i.e., total dosage), predicted treatment outcomes. Participants' characteristics such as age of onset of EIBI and severity of autism have also been identified as predictors of outcome (e.g., Frazier et al., 2021). More specifically, earlier onset of treatment and low severity of autism symptoms were associated with better language outcomes.

ABA Outside of Autism and Other Developmental Disabilities

Although ABA is most commonly known as the scientific basis for behavioral treatment provided to persons with autism, interventions based on the principles of ABA have also been used to address socially significant behaviors of other populations. For instance, in the study by Hanratty et al. (2016), teacher-implemented behavioral skills training (BST), in combination with in situ training and supplemental instructions, was successful in teaching preschool children gun safety skills (i.e., do not touch the gun; leave the area; tell an adult) and Hayes and Van Camp (2015) increased physical activity of elementary students during recess using a treatment package that included self-monitoring, goal setting, feedback, and reinforcement. Other examples include the use of prompts and removal of a trashcan to increase correct recycling by students, employees, and visitors of a university (Fritz et al., 2017), and the use of guest-delivered tokens to increase zoo employees' greetings of guests (Vergason & Gravina, 2020).

Given the expanding use of behavioral interventions with fields other than developmental disabilities, the Behavior Analyst Certification Board (BACB) (BACB, 2021a) published an executive summary describing the major subspecialty areas in ABA. These include Behavioral Treatment of Autism and other Developmental Disorders, Organizational Behavior Management (OBM), Behavior Analysis in Brain Injury Rehabilitation, Behavioral Gerontology, Clinical Behavior Analysis, Behavior Analysis in Education, Behavior Sport Psychology, Prevention and Behavioral Intervention of Child Maltreatment, Behavioral Treatment of Substance Use Disorders, Behavior Analysis in Environmental Sustainability, Behavior Analysis in Health and Fitness, and Behavior Pediatrics. A fact sheet and video introduction for each of the subspecialty areas are available on the BACB website (BACB, n.d.-a).

Evolution of the Science and Practice of Applied Behavior Analysis

Overall, behavior-analytic interventions have been shown to have a positive impact on the individuals receiving ABA therapy across skill areas (e.g., social, communication, behavior; see Section "Clinical Applications of ABA"). Additionally, ABA has been endorsed as an effective and evidence-based intervention by several scientific and professional entities (Myers & Jhonson, 2007; United States Surgeon General Satcher, 1999; American Psychological Association, 2017). However, ABA therapy has not gone without critique from professionals across other disciplines and the public. Some initial and on-going criticism presented by the neurodiversity movement and autism rights activists stems from the controversial components of the work of Ivaar Lovaas and the YAP, as well as others (e.g., Judge Rotenberg Center) (Leaf et al., 2021).

During the time of the YAP, circa 1960s–1970s, there was an increased likelihood that individuals with ASD would be institutionalized for their entire lives. The YAP and Lovaas "demonstrated an approach to improve the quality of life for individuals diagnosed with ASD. Children made tremendous progress in areas such as language, social behavior, and educational goals…institutionalization was no longer the norm or outcome for autistics/individuals diagnosed with ASD"

(Leaf et al., 2021); Concerns Over Ivar Lovaas and the UCLA.

Young Autism Project section). Criticisms of the YAP include its use of aversive procedures, such as shock and spanking, to treat "life-threatening" behavior, the comprehensive approach and intensity of recommended therapy hours (e.g., 40 hours per week), and that therapeutic programming was not individualized to each consumer's educational needs. Other criticisms of ABA from autism advocates within the neurodiversity movement include the use of certain behavior-analytic procedures (e.g., extinction, punishment), treatment of stereotypy, and the selection and implementation of non-therapeutic goals (Leaf et al., 2021).

However, the practice of behavior analysis was founded on and continues to emphasize compassion and a responsibility to humanity. More specifically, since its beginnings ABA has emphasized the importance of targeting only socially significant behavior (Baer et al., 1968). The practice of behavior analysis continues to focus on meaningful change, impacting a consumer's quality of life with its interventions, emphasizing a consumer's right to choose intervention (Bannerman et al., 1990), and incorporating different, replicable strategies to assess a consumer's preference for these interventions to ensure the social validity of treatment components (Hanley, 2010). Furthermore, Foxx (1998, p. 14) describes behavior analysts who truly embody the practice of ABA as "behavioral artists." He notes that "behavioral artists" exhibit qualities such as "likes people," "has a sense of humor," and is "self-actualized." Callahan et al. (2019) recommend "behavioral artistry" be incorporated into practitioner training and empirically evaluated to determine if these qualities in a behavior analyst produce even more meaningful change in consumers. Additionally, the practice of ABA continues to evolve as exemplified by the recent calls for and research related to compassionate care practices and to the development of successful relationships with its consumers. Taylor et al. (2019) highlighted the increasing need (i.e., raising numbers of practitioners, university training programs, and insurance mandates; see Section "Current State of the Practice of Applied Behavior Analysis") to develop more systematic training programs focused on the development of compassionate repertoires in practicing behavior analysts. The authors hypothesize establishing a positive, therapeutic relationship with the caregivers of consumers based on empathy and compassionate care could be vital to the acceptability of treatment and client outcomes.

Several studies (e.g., Kelly et al., 2015; Lugo et al., 2017, 2019) focused on the importance of the therapist–consumer relationship and developing the skills needed in practice to build rapport within that dyad. These studies empirically investigated a commonly used technique in ABA sessions referred to as "pairing" or "presession pairing." Although variations exist, pairing involves approaching a learner and making eye contact while presenting a preferred and/or reinforcing item, consuming the item (i.e., interacting with; ingesting it) with the learner, and describing the actions emitted with the item (Sundberg & Partington, 1998). Pairing can create a positive therapeutic environment for the learner and instructor and is recommended across several clinical manuals (Barbera, 2007; Sundberg & Partington, 1998). Kelly et al. (2015) determined that conducting a 2–4 min presession pairing interval with the therapist and consumer produced a reduction in challenging behavior across all three participants. Kelly et al. also noted there should be a natural transition to academic work (e.g., DTT) once a pairing interval has ceased and that interactions during pairing should be consumer-led (i.e., if a consumer requests to engage with a toy item in a certain way during pairing). In 2017, Lugo and colleagues extended Kelly et al.'s work by developing an operational definition of pairing that included the following procedural components: proximity, create, praise, reflect, imitate, describe, and initiate. These components were then taught to therapists with varying levels of experience using BST; results indicated that using this definition of pairing with BST increased both the accuracy of and frequency in which pairing was implemented with the consumer. Finally, Lugo et al. (2019) then evaluated the consumer's preference for pairing; results indicated that the consumers preferred pairing interactions with their therapists as compared to having free access to the same preferred toy items.

The practice of ABA continues to have critics, including those who have described ABA using terms such as "abuse" (Lynch, 2019) and state that ABA treatment can lead to undesirable outcomes (e.g., overgeneralized compliance, loss of individuality; Sequenzia, 2016) and symptoms of post-traumatic stress disorder (PTSD; Kupferstein, 2018). However, as discussed by Leaf and his co-authors (i.e., board-certified behavior analysts, licensed psychologists, parents, and autistics/individuals diagnosed with ASD; 2021), all of these criticisms do not have empirical support. For instance, the authors noted that shock therapy is almost nonexistent in present-day practice. Additionally, the authors provide data to refute many of the criticisms presented by neurodiversity and autism rights activists, as well as indicating areas in which ABA can still continue to evolve its practices to more robustly address these concerns. That is, some critics accuse extinction-based procedures to be "traumatic" for the consumer; however, Leaf et al. describe literature in which extinction-based procedures produced positive outcomes. They also recommended that behavior analysts evaluate the possibility that extinction-based procedures may result in trauma, as well as the actual consumer's preference for the procedures. Taken together, the data presented by these authors highlight the evolution of ABA therapy and how behavior analysts have continued and should continue to improve their technology and practice to meet the needs of all stakeholders.

In October 2021, the Autism Science Foundation (ASF), which consists of physicians, practitioners, researchers, and advocates, published a "Statement on Use of Applied Behavior Analysis (ABA) for Autism" in which the organization addresses "four main points regarding utility of ABA principles in autism intervention" (Autism Science Foundation, 2021). ASF's statement highlights the breadth of individualized techniques within the umbrella of behavior-analytic strategies, the continued evolution of quality ABA practices, the robust literature base spanning over 40 years confirming the efficacy of ABA, and the goal of behavior-analytic services being to increase the overall quality of life to the consumers and families. Just as behavior analysis has continuously evolved over the past 40 years, the field will continue to evolve in the next 40 years while maintaining Baer et al.'s (1968) focus on socially significant behavior change and the dimensions of ABA. This sentiment is reflected in more recent areas of publication in behavior analysis including in compassionate and family-centered care, trauma-assumed or trauma-informed care (Rajaraman et al., 2021), ethics in applied practice (LeBlanc et al., 2020), and cultural humility (Wright, 2019).

Current State of the Practice of Applied Behavior Analysis

From the seminal work of Baer et al. (1968), the field of applied behavior analysis has continued to evolve to meet the needs of its growing consumer base. To ensure protection of these consumers and the quality of services being provided to them, initiatives were developed and implemented such as a process for professional certification, ethical codes, and behavior-analytic practice guidelines. Since 1968, behavior analysts have established professional state organizations, advocated for insurance mandates across all 50 states, and developed quality assurance indicators and outcome measures for stakeholders.

Professional Certification and Licensing for Behavior Analysts

As the science and practice of behavior analysis continued to be disseminated during the 1970s and 1980s, there became an increasing need for a nationwide, professional certification entity. The early attempts to standardize training and testing requirements for behavior analysts, including the Minnesota Certification Program and Florida's

Certified Behavior Analyst distinction, established the framework necessary for what evolved into the Behavior Analyst Certification Board (BACB; Kelly et al., 2019). The BACB, founded as a non-profit corporation in 1998, has the mission "to protect consumers of behavior analysis services worldwide by systematically establishing, promoting, and disseminating professional standards" (BACB, n.d.-b).

Over the past two decades, the BACB has pursued the establishment and continued evolution of high-quality professional practice standards for the field of behavior analysis. Under current BACB standards, the following are available levels of certifications: Registered Behavior Technician (RBT), Board Certified Assistant Behavior Analyst (BCaBA), Board Certified Behavior Analyst (BCBA), and doctorate-level Board Certified Behavior Analyst (BCBA-D) (BACB, n.d.-c). Each of these certifications requires academic coursework (e.g., master's degree for BCBA; 40-hour approved course for RBT), initial and on-going supervised fieldwork hours standards (e.g., 2000 fieldwork hours for BCBA), and an examination. RBTs and BCaBAs are required to receive on-going, monthly clinical oversight from BCBAs, while all different levels of certification also require annual (i.e., RBT) or biannual (i.e., BCaBA, BCBA, BCBA-D) renewal standards. According to certificant data from the BACB in October 2021, the following were individuals with each level of certification: BCBA 50,749; BCaBA 5364; RBT 109,088 (BACB, 2021b). To fulfill its global mission, the BACB provided oversight to individuals pursuing and maintaining professional certification within the United States and numerous other countries. After extensive consideration and analysis of several variables (BACB, 2019), as of January 1, 2023, the BACB will only accept applications for certification in the United States and Canada (i.e., certifications earned prior to that date will be honored for on-going renewal into the future).

Two examples of other certification organizations for behavior analysts are the Qualified Applied Behavior Analysis Credentialing Board (QABA) (QABA, n.d.-a) and the International Behavior Analysis Organization (IBAO) (IBAO, n.d.-a). Their certification standards include distinguishing coursework and supervised practice requirements, a certification examination, on-going professional and/or clinical oversight, and continuing education certification renewal processes. Both organizations have multiple levels of certifications, including certifications for those who deliver direct, behavior-analytic services to consumers, and those who are responsible for the case and supervision of the therapists. For example, QABA provides an Applied Behavior Analysis Technician (ABAT) certification for individuals who deliver direct, behavior-analytic services to consumers (QABA, n.d.-b). An ABAT can then be supervised by a Qualified Autism Service Practitioner-Supervisor (QASP-S) (QABA, n.d.-c), which requires a minimum of a bachelor's degree from an accredited university and approved coursework, or a master's level Qualified Behavior Analyst (QBA) (QABA, n.d.-d). Similarly, IBAO includes an International Behavior Therapist (IBT), which requires a 40-hour training, 300 hours of supervised practice, and other supervision-related tasks and activities (IBAO, n.d.-b). IBTs typically implement the behavior-analytic interventions, which are overseen by International Behavior Analysts (IBA) (IBAO, n.d.-c).

In addition to professional certification, several states have established licensure mandates for applied behavior analysts; that is, in these states only individuals with a license from that state can both engage in activities related to (i.e., "practice") and refer to themselves as applied behavior analysts (i.e., "title") (Green & Johnston, 2009). These states have a state board that regulates the on-going practice of behavior analysis, including the cadence of a renewal for the provider's license (e.g., annual, biannual, etc.). One of the primary reasons for state licensure is added protection of consumers who are receiving ABA services (Dorsey et al., 2009). For instance, the state licensing board monitors and investigates any complaints of unethical practices (Dorsey et al., 2009). The first two states to require licensure for behavior analysts were Nevada and Oklahoma in 2019. Currently, in the United States 33 states require professional licensure (BACB, n.d.-d).

Professional Ethics and Treatment Guidelines

Behavior analysts are required to "do no harm" and ensure that all consumers are receiving treatment with human dignity and respect at the forefront of all decision-making. The history of behavior modification or practicing behavioral science is unfortunately similar to other medical practices, particularly those serving the most vulnerable populations, in that consumers have experienced mistreatment and/or have their rights violated. For instance, the egregious and inexcusable case of the Sunland Training Center in Miami during the 1970s involved rampant misuse of aversive behavior modification strategies leading to severe abuse and neglect of a multitude of residents with developmental disabilities. It propelled the immediate need to establish organizational and state-wide peer review committees, which led to a future ethical practice code alongside the professional governing body. The resulting Blue Ribbon Panel and investigating committee determined the necessary layers of administrative oversight, training, and monitoring of individual consumer progress to then ensure the highest quality of compassionate care and prevent consumers from any mistreatment (Bailey & Burch, 2016).

The work of the Blue Ribbon Panel and subsequent local and legislative quality assurance initiatives would provide the foundation for the BACB to later establish the *Professional and Ethical Compliance Code for Behavior Analysts* in January 2016 (BACB, n.d.-e). As of January 2022, the BACB instituted a revised version renamed the *Ethics Code for Behavior Analysts* (BACB, n.d.-f). The *Ethics Code* includes a range of ethical standards across the practice of behavior analysis including: professional integrity and practicing and maintaining scientific and clinical competence, cultural responsiveness and diversity, assessment and on-going treatment of clients, client rights, on-going dissemination of the science and practice of behavior analysis, etc. Along with the *Ethics Code*, the BACB Ethics Department enforces compliance to the code, monitors and investigates any professional certification complaints from stakeholders, and issues any disciplinary sanctions or completing revoking certifications as warranted as a result of being in noncompliance with the code (BACB, n.d.-g). Other credentialing organizations also require their certificants to practice according to a set of professional and ethical guidelines (i.e., *QABA Ethical Code of Conduct; IBAO Ethical Guidelines, The Ethical Problem Solving Model & The Addendum of Examples and Interpretations*) (QABA, n.d.-e; IBAO, n.d.-d).

Numerous stakeholders across the United States have simultaneously and tirelessly advocated for mandated insurance coverage for behavior-analytic services for individuals diagnosed with autism. The milestone of all 50 states requiring this mandate was achieved in 2019, with Tennessee being the final state (i.e., Indiana being the first state in 2001) (Autism Speaks, 2019; Kelly et al., 2019). To meet the continued and growing need for standards for high-quality care and delivery of services across both insurance funders and behavior-analytic providers, in 2012 the BACB published the *Applied Behavior Analysis Treatment of Autism Spectrum Disorder: Practice Guidelines for Healthcare Funders and Managers*. These *ASD Practice Guidelines* outline components of service delivery including best practice guidance for recommending medically necessary levels of treatment (i.e., focused vs. comprehensive treatment models), appropriate ratios of direct care to clinical oversight (i.e., RBT services vs. BCBA guidance and treatment modification), and effective structuring of case management across certification levels (i.e., a caseload with BCaBA support vs. without BCaBA support). In March 2020, the *ASD Practice Guidelines* were then transferred from the BACB to the Council of Autism Service Providers (CASP) (BACB, 2020).

Pursuit of Continued Quality Assurance

As the total number of BACB certificants exponentially increases annually and the demand for services increases due to insurance mandates throughout the United States and the increase in incidence of autism (CDC, 2021), the need for continued quality assurance measures grows along with the practice of behavior analysis. Examples of organizations formed recently to promote quality assurance include CASP, the Behavioral Health Center of Excellence (BHCOE), and the International Consortium for Health Outcomes Management (ICHOM). In December 2015, CASP formed as an organization to serve the interests of service providers, consumers, and stakeholders "with the purpose to establish standards and define expected outcomes of quality and evidence-based treatment" (CASP, n.d.). CASP's aforementioned *ASD Practice Guidelines* focus on these quality standards of care for organizations to create systems to utilize these recommendations. BHCOE was created in 2015 and this organization provides accreditation to ABA agencies who demonstrate compliance with a variety of quality assurance metrics, including measuring and monitoring consumer outcome data, specified in their "Accreditation Standards" (BHCOE, 2021). These "Accreditation Standards" define the expectations for an agency to demonstrate quality care across areas like patient intake, service delivery, clinical documentation, etc. Finally, with the practice of ABA likely transitioning to a more medical model of value-based care, other organizations like the ICHOM, which was founded in 2012, have provided a system to benchmark client outcomes or a "standard set" of clinical assessments to measure consumers' success with services (i.e., ICHOM has currently published 39 standard sets) (ICHOM, n.d.-a). ICHOM's "standard sets" span a wide variety of medical conditions and diagnoses, including lung cancer, addiction, and depression and anxiety. While ICHOM does not have a "standard set" for ABA services since they focus on general outcome measures, not a specific therapy, their "Autism Spectrum Disorder Standard Set" will provide ABA agencies a method of benchmarking progress for their clients and evaluating the quality of their care (ICHOM, n.d.-b). All of these joint initiatives by professional organizations focusing on outcome measures and monitoring the increases in quality of life of consumers will continue to drive the field of behavior analysis to increase expectations of excellence in clinical practice.

References

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). American Psychiatric Association

American Psychiatric Association (Ed.). (2013). Diagnostic and statistical manual of mental disorders (5th ed.). American Psychiatric Association

American Psychological Association. (2017). *APA policy: Applied behavior analysis*. http://www.apa.org/about/policy/applied-behavior-analysis

Association for Science in Autism Treatment. (n.d.). *Learn more about specific treatments*. https://asatonline.org/for-parents/learn-more-about-specific-treatments/

Autism Science Foundation. (2021, Oct 28). *Statement on use of applied behavior analysis (ABA) for autism*. https://autismsciencefoundation.org/news/statement-on-use-of-applied behavior-analysis-aba-for-autism

Autism Speaks. (2019, Aug 3). *Autism speaks commends Tennessee as it becomes 50th state requiring that insurance plans cover autism*. http://www.autismspeaks.org/pressrelease/autism-speaks-commends-tennessee-it-becomes-50th-state-requiring-insuranceplans

Ayllon, T., & Michael, J. (1959). The psychiatric nurse as a behavioral engineer 1. *Journal of the Experimental Analysis of Behavior, 2*(4), 323–334. https://doi.org/10.1901/jeab.1959.2-323

Bailey, J. S., & Burch, M. R. (2016). How we got here. In *Ethics for behavior analysts* (3rd ed., pp. 3–14). Routledge.

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The rights of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Applied Behavior Analysis, 23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Barahona-Corrêa, J. B., & Filipe, C. N. (2016). A concise history of Asperger syndrome: The short reign of a troublesome diagnosis. *Frontiers in Psychology, 6*, 2024. https://doi.org/10.3389/fpsyg.2015.02024

Barbera, M. L. (2007). *The verbal behavior approach: How to teach children with autism and related disorders*. Jessica Kingsley Publishers.

Behavior Analyst Certification Board (BACB). (2019, Dec 30). *Recent changes to the BACB's international focus.* https://www.bacb.com/wp-content/uploads/2020/06/RecentChanges-to-International-Focus_200520.pdf

Behavior Analyst Certification Board (BACB). (2020, March 25). *ASD practice guidelines find new home with CASP.* http://www.bacb.com/asd-practice-guidelines-find-new-homewith-casp/

Behavior Analyst Certification Board (BACB). (2021a, Jan). *Applied behavior analysis subspecialty areas.* https://www.bacb.com/wp-content/uploads/2020/05/Executive-Summary_210125.pdf

Behavior Analyst Certification Board (BACB). (2021b, Oct 1). *BACB certificant data*. https://www.bacb.com/bacb-certificant-data

Behavior Analyst Certification Board (BACB). (n.d.-a.). *About behavior analysis.* https://www.bacb.com/about-behavior-analysis/

Behavior Analyst Certification Board (BACB). (n.d.-b). *About the BACB*. https://www.bacb.com/about/

Behavior Analyst Certification Board (BACB). (n.d.-c). *Credentials*. https://www.bacb.com/

Behavior Analyst Certification Board (BACB). (n.d.-d). *U.S. licensure of behavior analysts*. https://www.bacb.com/u-s-licensure-of-behavior-analysts

Behavior Analyst Certification Board (BACB). (n.d.-e). *Professional and Ethical Compliance Code for Behavior Analysts*. https://www.bacb.com/wp-content/uploads/2020/05/BACBCompliance-Code-english_190318.pdf

Behavior Analyst Certification Board (BACB). (n.d.-f). *Ethics code for behavior analysts.* https://www.bacb.com/wp-content/uploads/2020/11/Ethics-Code-for-Behavior-Analysts210902.pdf

Behavior Analyst Certification Board (BACB). (n.d.-g). *Ethics*. https://www.bacb.com/ethicsinformation

Behavioral Health Center of Excellence (BHCOE). (2021). *BHCOE accreditation standards*. https://www.bhcoe.org/standards/

B. F. Skinner Foundation. (n.d.). Biographical Information. https://www.bfskinner.org/archives/biographical-information/

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Baum, W. M. (2011). What is radical behaviorism? A review of Jay Moore's conceptual foundation of radical behaviorism. *Journal of the Experimental Analysis of Behavior, 95*(1), 119–126. https://doi.org/10.1901/jeab.2011.95-119

Callahan, K., Foxx, R. M., Swierczynski, A., Aerts, X., Mehta, S., McComb, M. E., Nichols, S. M., Segal, G., Donald, A., & Sharma, R. (2019). Behavioral artistry: Examining the relationship between the interpersonal skills and effective practice repertoires of applied behavior analysis practitioners. *Journal of Autism and Developmental Disorders, 49*, 3557–3570. https://doi.org/10.1007/s10803-019-04082-1

Carr, E. G. (1977). The motivation of self-injurious behavior: A review of some hypotheses. *Psychological Bulletin, 84*(4), 800–816. https://doi.org/10.1037/0033-2909.84.4.800

Catania, A. C., & Laties, V. G. (1999). Pavlov and Skinner: Two lives in science (an introduction to BF Skinner's "some responses to the stimulus 'Pavlov'"). *Journal of the Experimental Analysis of Behavior, 72*(3), 455–461. https://doi.org/10.1901/jeab.1999.72-455

Centers for Disease Control and Prevention. (2021, Dec 1). *Autism and developmental disabilities monitoring (ADDM) network.* https://www.cdc.gov/ncbddd/autism/addm.html

Chance, P. (1999). Thorndike's puzzle boxes and the origins of the experimental analysis of behavior. *Journal of the Experimental Analysis of Behavior, 72*(3), 433–440. https://doi.org/10.1901/jeab.1999.72-433

Clark, R. E. (2004). The classical origins of Pavlov's conditioning. *Integrative Physiological & Behavioral Science, 39*(4), 279–294. https://doi.org/10.1007/BF02734167

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis*. Pearson.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis*. Pearson.

Dawson, G. (2008). Early behavioral intervention, brain plasticity, and the prevention of autism spectrum disorder. *Development and Psychopathology, 20*(3), 775–803. https://doi.org/10.1017/S0954579408000370

Dawson, G., Rogers, S., Munson, J., Smith, M., Winter, J., Greenson, J., Donaldson, A., & Varley, J. (2010). Randomized, controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics, 125*(1), 17–23. https://doi.org/10.1542/peds.2009-0958

De Melo, C. M., de Castro, M. S. L. B., & de Rose, J. C. (2015). Some relations between culture, ethics and technology in B. F. Skinner. *Behavior and Social Issues, 24*(1), 39–55.

Dewsbury, D. A. (1997). In celebration of the centennial of Ivan P. Pavlov's (1897/1902) The Work of the Digestive Glands. *American Psychologist, 52*(9), 933–935. https://doi.org/10.1037/0003-066X.52.9.933

Dorsey, M. F., Weinberg, M., Zane, T., & Guidi, M. M. (2009). The case for licensure of applied behavior analysts. *Behavior Analysis in Practice, 2*(1), 53–58. https://doi.org/10.1007/BF03391738

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2009). Meta-analysis of early intensive behavioral intervention for children with autism. *Journal of Clinical Child & Adolescent Psychology, 38*(3), 439–450. https://doi.org/10.1080/15374410902851739

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2010). Using participant data to extend the evidence base for intensive behavioral intervention for children with autism. *American Journal on Intellectual and Developmental*

Disabilities, 115(5), 381–405. https://doi.org/10.1352/1944-7558-115.5.381
Eikeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2007). Outcome for children with autism who began intensive behavioral treatment between ages 4 and 7: A comparison study. *Behavior Modification, 31*, 264–278. https://doi.org/10.1177/0145445506291396
Eikeseth, S. (2009). Outcome of comprehensive psycho-educational interventions for young children with autism. *Research in Developmental Disabilities, 30*(1), 158–178. https://doi.org/10.1016/j.ridd.2008.02.003
Estes, W. K., & Skinner, B. F. (1999). Some quantitative properties of anxiety. In B. F. Skinner, V. G. Laties, & A. C. Catania (Eds.), *Cumulative record* (Definitive ed., pp. 558–569). The B. F. Skinner Foundation.
Ferster, C. B., & DeMeyer, M. K. (1961). The development of performances in autistic children n an automatically controlled environment. *Journal of Chronic Disease, 13*, 312–345. https://doi.org/10.1016/0021-9681(61)90059-5
Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. Appleton-Century-Crofts.
Foxx, R. M. (1998). Twenty-five years of applied behavior analysis: Lessons learned. *Discriminanten, 4*, 13–31.
Fuller, P. R. (1949). Operant conditioning of a vegetative human organism. *Journal of Psychology, 62*, 587–590. https://doi.org/10.2307/1418565
Frazier, T. W., Klingemier, E. W., Anderson, C. J., Gengoux, G. W., Youngstrom, E. A., & Hardan, A. Y. (2021). A longitudinal study of language trajectories and treatment outcomes of early intensive behavioral intervention for autism. *Journal of Autism and Developmental Disorders, 51*(12), 4534–4550. https://doi.org/10.1007/s10803-021-04900-5
Fritz, J. N., Dupuis, D. L., Wu, W. L., Neal, A. E., Rettig, L. A., & Lastrapes, R. E. (2017). Evaluating increased effort for item disposal to improve recycling at a university. *Journal of Applied Behavior Analysis, 50*(4), 825–829. https://doi.org/10.1002/jaba.405
Gewirtz, J. L. (2001). J. B. Watson's approach to learning: Why Pavlov? Why not Thorndike? *Behavioral Development Bulletin, 10*(1), 23–25. https://doi.org/10.1037/h0100478
Green, G., & Johnston, J. M. (2009). A primer on professional credentialing: Introduction to invited commentaries on licensing behavior analysts. *Behavior Analysis in Practice, 2*(1), 51–52. https://doi.org/10.1007/BF03391737
Haggbloom, S. J., Warnick, R., Warnick, J. E., Jones, V. K., Yarbrough, G. L., Russell, T. M., Borecky, C. M., McGahhey, R., Powell, J. L., III, Beavers, J., & Monte, E. (2002). The 100 most eminent psychologists of the 20th century. *Review of General Psychology, 6*(2), 139–152. https://doi.org/10.1037/1089-2680.6.2.139
Hanley, G. P. (2010). Toward effective and preferred programming: A case for the objective measurement of social validity with recipients of behavior-change programs. *Behavior Analysis in Practice, 3*(1), 13–21. https://doi.org/10.1007/BF03391754
Hayes, L. B., & Van Camp, C. M. (2015). Increasing physical activity of children during school recess. *Journal of Applied Behavior Analysis, 48*(3), 690–695. https://doi.org/10.1002/jaba.222
Hanratty, L. A., Miltenberger, R. G., & Florentino, S. R. (2016). Evaluating the effectiveness of a teaching package utilizing behavioral skills training and in situ training to teach gun safety skills in a preschool classroom. *Journal of Behavioral Education, 25*(3), 310–323. https://doi.org/10.1007/s10864-016-9248-1
Healthline (2021, Nov 1). *Everything you need to know about autism spectrum disorder (ASD)*. https://www.healthline.com/health/autism
Heward, W. L., & Cooper, J. O. (1992). Radical behaviorism: A productive and needed philosophy for education. *Journal of Behavioral Education, 2*(4), 345–365. https://doi.org/10.1007/BF00952354
Höfer, J., Hoffmann, F., & Bachmann, C. (2017). Use of complementary and alternative medicine in children and adolescents with autism spectrum disorder: A systematic review. *Autism, 21*(4), 387–402. https://doi.org/10.1177/1362361316646559
Howard, J. S., Sparkman, C. R., Cohen, H. G., Green, G., & Stanislaw, H. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities, 26*(4), 359–383. https://doi.org/10.1016/j.ridd.2004.09.005
Horner, R. H., Carr, E. G., Halle, J., McGee, G., Odom, S., & Wolery, M. (2005). The use of single-subject research to identify evidence-based practice in special education. *Exceptional Children, 71*(2), 165–179. https://doi.org/10.1177/001440290507100203
Harvard University. (n.d.). An expanded bibliography of the published primary-source works of B. F. Skinner: with references to works reprinted in Skinner's collections and texts. https://psychology.fas.harvard.edu/people/b-f-skinner
Institute of Medicine (US) Immunization Safety Review Committee. (2004). *Immunization safety review: Vaccines and autism*. National Academies Press (US).
International Behavior Analysis Organization (IBAO). (n.d.-a). *International behavior analysis certifications*. https://theibao.com
International Behavior Analysis Organization (IBAO). (n.d.-b). *International behavior therapist*. https://theibao.com/international_behavior_therapist
International Behavior Analysis Organization (IBAO). (n.d.-c). *International behavior analyst*. https://theibao.com/international_behavior_analyst
International Behavior Analysis Organization (IBAO). (n.d.-d). *Ethics*. https://theibao.com/ethics.
International Consortium for Health Outcomes Measuring (ICHOM). (n.d.-a). *Frequently asked questions*. https://www.ichom.org/faqs
International Consortium for Health Outcomes Measuring (ICHOM). (n.d.-b). *Standard sets:Autism spectrum disorder*. https://www.ichom.org/faqs
Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. https://doi.org/10.1901/jaba.1994.27-197

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*, 217–250.

Kelly, A. N., Axe, J. B., Allen, R. F., & Maguire, R. W. (2015). Effects of presession pairing on the challenging behavior and academic responding of children with autism. *Behavioral Interventions, 30*, 135–156. https://doi.org/10.1002/bin.1408

Kelly, M. P., Martin, N., Dillenburger, K., Kelly, A. N., & Miller, M. M. (2019). Spreading the news: History, successes, challenges and the ethics of effective dissemination. *Behavior Analysis in Practice, 12*(2), 440–451. https://doi.org/10.1007/s40617-018-0238-8

Kupferstein, H. (2018). Evidence of increased PTSD symptoms in autistics exposed to applied behavior analysis. *Advances in Autism, 4*(1), 19–29. https://doi.org/10.1108/AIA-08-2017-0016

LeBlanc, L. A., Onofrio, O. M., Valentino, A. L., & Sleeper, J. D. (2020). Promoting ethical discussions and decision making in a human service agency. *Behavior Analysis in Practice, 13*(4), 905–913. https://doi.org/10.1007/s40617-020-00454-7

Landa, R. J. (2018). Efficacy of early interventions for infants and young children with, and at risk for, autism spectrum disorders. *International Review of Psychiatry (Abingdon, England), 30*(1), 25–39. https://doi.org/10.1080/09540261.2018.1432574

Leaf, J. B., Cihon, J. H., Leaf, R., McEachin, J., Liu, N., Russell, N., Unumb, L., Shapiro, S., & Khosrowshahi, D. (2021). Concerns about ABA-based intervention: An evaluation and recommendations. *Journal of Autism and Developmental Disorders*. Advance online publication. https://doi.org/10.1007/s10803-021-05137-y

Leigland, S. (2010). Functions of research in radical behaviorism for the further development of behavior analysis. *The Behavior Analyst, 33*(2), 207–222. https://doi.org/10.1007/BF03392220

LeBlanc, L. A., & Gillis, J. M. (2012). Behavioral interventions for children with autism spectrum disorders. *Pediatric Clinics, 59*(1), 147–164. https://doi.org/10.1016/j.pcl.2011.10.006

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*(1), 3. https://psycnet.apa.org/doi/10.1037/0022-006X.55.1.3

Lugo, A. M., King, M. L., Lamphere, J. C., & McArdle, P. E. (2017). Developing procedures to improve therapist-child rapport in early intervention. *Behavior Analysis in Practice, 10*(4), 395–401. https://doi.org/10.1007/s40617-016-0165-5

Lugo, A. M., McArdle, P. E., King, M. L., Lamphere, J. C., Peck, J. A., & Beck, H. J. (2019). Effects of presession pairing on preference for therapeutic conditions and challenging behavior. *Behavior Analysis in Practice, 12*(1), 188–193. https://doi.org/10.1007/s40617-018-0268-2

Lynch, C. L. (2019, March 28). *Invisible abuse: ABA and the things only autistic people can see.* https://neuroclastic.com/2019/03/28/invisible-abuse-aba-and-the-things-only-autistic-people-can-see/

Malone, J. C. (2014). Did John B. Watson really "found" behaviorism? *The Behavior Analyst, 37*(1), 1–12. https://doi.org/10.1007/s40614-014-0004-3

Mannion, A., & Leader, G. (2013). Comorbidity in autism spectrum disorder: A literature review. *Research in Autism Spectrum Disorders, 7*(12), 1595–1616. https://doi.org/10.1016/j.rasd.2013.09.006

Marcus, L., Schopler, L., & Lord, C. (2000). TEACCH services for preschool children. In J. Handleman & S. Harris (Eds.), *Preschool education programs for children with autism* (2nd ed., pp. 215–232). PRO-ED.

Mayo Clinic. (n.d.). *Autism spectrum disorder*. https://www.mayoclinic.org/diseases-conditions/autism-spectrum-disorder/symptoms-causes/syc-20352928

McEachin, J. J., Smith, T., & Lovaas, O. I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal of Mental Retardation, 97*(4), 359–391.

Mesibov, G. B., & Shea, V. (2010). The TEACCH program in the era of evidence-based practice. *Journal of Autism and Developmental Disorders, 40*(5), 570–579. https://doi.org/10.1007/s10803-009-0901-6

Myers, S. M., & Johnson, C. P. (2007). Management of children with autism spectrum disorders. *Pediatrics, 120*(5), 1162–1182. https://doi.org/10.1542/peds.2007-2362

Michael, J. (1984). Verbal behavior. *The Experimental Analysis of Behavior, 42*(3), 363–376. https://doi.org/10.1901/jeab.1984.42-363

Moore, J. (2010). What do mental terms mean?. *The Psychological Record, 60*, 699–714. https://doi.org/10.1007/BF03395740

Moore, J. (2011). Behaviorism. *The Psychological Record, 61*(3), 449–465. https://doi.org/10.1007/BF03395771

Moore, J. (2017). John B. Watson's classical S–R behaviorism. *The Journal of Mind and Behavior, 38*(1), 1–34. http://www.jstor.org/stable/44631526

Morris, E. K., Smith, N. G., & Altus, D. E. (2005). B. F. Skinner's contributions to applied behavior analysis. *The Behavior Analyst, 28*(2), 99–131. https://doi.org/10.1007/BF03392108

Morris, E. K., Altus, D. E., & Smith, N. G. (2013). A study in the founding of applied behavior analysis through its publications. *The Behavior Analyst, 36*(1), 73–107. https://doi.org/10.1007/BF03392293

National Institutes of Health (NIH). (2021a, April 4). *Medication treatment for autism.* U.S. Department of Health and Human Services. https://www.nichd.nih.gov/health/topics/autism/conditioninfo/treatments/medication-treatment#f2

National Institutes of Health (NIH). (2021b, April 19). *Early intervention for autism.* U.S. Department of Health and Human Services. https://www.nichd.nih.gov/health/topics/autism/conditioninfo/treatments/early-intervention

National Research Council. (2001). *Educating children with autism*. National Academy Press.

Odom, S. L., Boyd, B. A., Hall, L. J., & Hume, K. (2010a). Evaluation of comprehensive treatment models for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 40*(4), 425–436. https://doi.org/10.1007/s10803-009-0825-1

Odom, S. L., Collet-Klingenberg, L., Rogers, S. J., & Hatton, D. D. (2010b). Evidence-based practices in interventions for children and youth with autism spectrum disorders. *Preventing School Failure: Alternative Education for Children and Youth, 54*(4), 275–282. https://doi.org/10.1080/10459881003785506

Palmer, D. C. (2009). The role of private events in the interpretation of complex behavior. *Behavior and Philosophy, 37*, 3–19. http://www.jstor.org/stable/41472419

Peters-Scheffer, N., Didden, R., Korzilius, H., & Matson, J. (2012). Cost comparison of early intensive behavioral intervention and treatment as usual for children with autism spectrum disorder in The Netherlands. *Research in Developmental Disabilities, 33*(6), 1763–1772. https://doi.org/10.1016/j.ridd.2012.04.006

Poling, A., Schlinger, H., Starin, S., & Blakely, E. (1990). *Psychology: A behavioral overview*. Plenum Press.

Qualified Applied Behavior Analysis Credentialing Board (QABA). (n.d.-a). *About QABA*. https://qababoard.com/about

Qualified Applied Behavior Analysis Credentialing Board (QABA). (n.d.-b). *Applied behavior analysis technician (ABAT) requirements*. https://qababoard.com/aba-technician-credential

Qualified Applied Behavior Analysis Credentialing Board (QABA). (n.d.-c). *Qualified autism service practitioner-supervisor (QASP-S) requirements*. https://qababoard.com/qualified-autism-services-practitioner-supervisor

Qualified Applied Behavior Analysis Credentialing Board (QABA). (n.d.-d). *Qualified behavior analyst (QBA) requirements*. https://qababoard.com/qualified-autism-services-practitioner-supervisor

Qualified Applied Behavior Analysis Credentialing Board (QABA). (n.d.-e). *QABA ethical code of conduct*. https://qababoard.com/code-of-ethics

Rajaraman, A., Austin, J. L., Gover, H. C., Cammilleri, A. P., Donnelly, D. R., & Hanley, G. P. (2021). Toward trauma-informed applications of behavior analysis. *Journal of Applied Behavior Analysis*. Advance online publication. https://doi.org/10.1002/jaba.881

Reichow, B., Barton, E. E., Boyd, B. A., & Hume, K. (2012). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Cochrane Database of Systematic Reviews, 10*, 23–41. https://doi.org/10.1002/14651858.CD009260.pub2

Reichow, B., & Wolery, M. (2009). Comprehensive synthesis of early intensive behavioral interventions for young children with autism based on the UCLA Young Autism Project Model. *Journal of Autism and Developmental Disorders, 39*, 23–41. https://doi.org/10.1007/s10803-008-0596-0

Rogers, S. J., & Vismara, L. A. (2008). Evidence-based comprehensive treatments for early autism. *Journal of Clinical Child & Adolescent Psychology, 37*(1), 8–38.

Rogers, S. J. (2013). Early start Denver model. In F. R. Volkmar (Ed.), *Encyclopedia of autism Spectrum disorders* (pp. 1034–1042). Springer.

Rosen, N. E., Lord, C., & Volkmar, F. R. (2021). The diagnosis of autism: From Kanner to DSM-III to DSM-5 and beyond. *Journal of Autism and Developmental Disorders, 51*(12), 4253–4270. https://doi.org/10.1007/s10803-021-04904-1

Rutherford, A. (2017). B. F. Skinner and technology's nation: Technocracy, social engineering, and the good life in 20th-century America. *History of Psychology, 20*(3), 290–312.

Satcher, D. (1999). *Mental health: A report of the surgeon general*. U.S. Public Health Service.

Sallows, G. O., & Graupner, T. D. (2005). Intensive behavioral treatment for children with autism: Four-year outcome and predictors. *American Journal of Mental Retardation, 110*(6), 417–438. https://doi.org/10.1352/0895-8017(2005)110[417:IBTFCW]2.0.CO;2

Sequenzia, A. (2016, April 27). *Autistic conversion therapy*. https://awnnetwork.org/autistic-conversion-therapy/?fbclid=IwAR1KVUN-h6qJ6paWxAwX2H22PH8ApGHQJqG9F4arjzWKrZVNh7Z9cp5GBJ4

Schlinger, H. D. (2011). Skinner as missionary and prophet: A review of Burrhus F Skinner: Shaper of behaviour. *Journal of Applied Behavior Analysis, 44*(1), 217–225. https://doi.org/10.1901/jaba.2011.44-217

Schlinger, H. D., Jr., & Normand, M. P. (2013). On the origin and functions of the term functional analysis. *Journal of Applied Behavior Analysis, 46*(1), 285–288. https://doi.org/10.1002/jaba.6

Schlinger, H. D. (2021). The impact of B. F. Skinner's science of operant learning on early childhood research, theory, treatment, and care. *Early Child Development and Care, 191*(7–8), 1–18. https://doi.org/10.1080/03004430.2020.1855155

Scheider, S. M., & Morris, E. K. (1987). A history of the term radical behaviorism: From Watson to Skinner. *The Behavior Analyst, 10*(1), 27–39.

Shillingsburg, M. A., Frampton, S. E., Juban, B., Weddle, S. A., & Silva, M. R. (2021). Implementing an applied verbal behavior model in classrooms. *Behavioral Interventions*. Advance online publication. https://doi.org/10.1002/bin.1807

Smith, T., Groen, A. D., & Wynn, J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal on Mental Retardation, 105*(4), 269–285. https://doi.org/10.1352/0895-8017(2000)1052.0.co;2

Smith, N. G., & Morris, E. K. (2014). *An expanded bibliography of the published primary-source works of B. F. Skinner: With references to works reprinted in Skinner's collections and texts*. http://bfskinner.org/wp-content/uploads/2014/02/SmithMorrisBibliography.pdf

Steinbrenner, J. R., Hume, K., Odom, S. L., Morin, K. L., Nowell, S. W., Tomaszewski, B., Szendrey, S., McIntyre, N. S., Yücesoy-Özkan, S., & Savage, M. N. (2020). *Evidence-based practices for children, youth, and young adults with autism*. The University of North

Carolina at Chapel Hill, Frank Porter Graham Child Development Institute, National Clearinghouse on Autism Evidence and Practice Review Team.
Skinner, B. F., & Heron, W. T. (1937). Effects of caffeine and Benzedrine upon conditioning and extinction. *The Psychological Record, 1*, 340–346.
Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. Appleton-Century.
Skinner, B. F. (1948). *Walden two*. Macmillan.
Skinner, B. F. (1953). *Science and human behavior*. Macmillan.
Skinner, B. F., Solomon, H. C., & Lindsley, O. R. (1954). A new method for the experimental analysis of behavior of psychotic patients. *The Journal of Nervous and Mental Disease, 120*, 403–406.
Skinner, B. F. (1957). *Verbal behavior*. Appleton-Century-Croft.
Skinner, B. F. (1958). Teaching machines. *Science, 128*(3330), 969–977. https://www.jstor.org/stable/1755240
Skinner, B. F. (1966). What is the experimental analysis of behavior? *Journal of the Experimental Analysis of Behavior, 9*(3), 213–218. https://doi.org/10.1901/jeab.1966.9-213
Skinner, B. F. (1971). *Beyond freedom and dignity*. Knopf.
Skinner, B. F. (1974). *About behaviorism*. Knopf.
Skinner, B. F. (1978). *Reflections on behaviorism and society*. Prentice-Hall.
Skinner, B. F. (1999a). Contingency management in the classroom. In B. F. Skinner, V. G. Laties, & A. C. Catania (Eds.), *Cumulative record* (Definitive ed., pp. 271–281). The B. F. Skinner Foundation.
Skinner, B. F. (1999b). What is psychotic behavior? In B. F. Skinner, V. G. Laties, & A. C. Catania (Eds.), *Cumulative Record* (Definitive ed., pp. 287–301). The B. F. Skinner Foundation.
Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism or other developmental disabilities*. Pleasant Hill, CA: Behavior Analysts, Inc.
Sundberg, M. L., & Schlinger, H. D. (2021). Standing on the shoulders of a giant: Remembrances of Jack Michael, part 1. *The Analysis of Verbal Behavior*. Advance online publication. https://doi.org/10.1007/s40616-021-00150-9
Taylor, B. A., LeBlanc, L. A., & Nosik, M. R. (2019). Compassionate care in behavior analytic treatment: Can outcomes be enhanced by attending to relationships with caregivers? *Behavior Analysis in Practice, 12*(3), 654–666. https://doi.org/10.1007/s40617-01800289-3
The Council for Autism Service Providers (CASP). (n.d.). *Purpose*. https://casproviders.org/mission-vision/
Thorndike, E. L. (1898). Animal intelligence: An experimental study of the associative processes in animals. *The Psychological Review: Monograph Supplements, 2*(4), i–109. https://doi.org/10.1037/h0092987
Vargas, E. A. (2017). B. F. Skinner's theory of behavior. *European Journal of Behavior Analysis, 18*(1), 2–38. https://doi.org/10.1080/15021149.2015.1065640
Vergason, C., & Gravina, N. (2020). Using a guest-delivered token economy to increase employee-guest interactions at a zoo. *Journal of Applied Behavior Analysis, 53*(1), 422–430. https://doi.org/10.1002/jaba.599
Virués-Ortega, J. (2010). Applied behavior analytic intervention for autism in early childhood: Meta-analysis, meta-regression and dose–response meta-analysis of multiple outcomes. Clinical Psychology Review, 30(4), 387–399. https://doi.org/10.1016/j.cpr.2010.01.008
Virués-Ortega, J., Julio, F. M., & Pastor-Barriuso, R. (2013a). The TEACCH program for children and adults with autism: A meta-analysis of intervention studies. *Clinical Psychology Review, 33*(8), 940–953. https://doi.org/10.1016/j.cpr.2013.07.005
Virués-Ortega, J., Rodríguez, V., & Yu, C. T. (2013b). Prediction of treatment outcomes and longitudinal analysis in children with autism undergoing intensive behavioral intervention. *International Journal of Clinical and Health Psychology, 13*(2), 91–100. https://doi.org/10.1016/S1697-2600(13)70012-7
Watson, J. B., & Rayner, R. (1920). Conditioned emotional reactions. *Journal of Experimental Psychology, 3*(1), 1–14. https://doi.org/10.1037/h0069608
Wolf, M., Risley, T., Johnston, M., Harris, F., & Allen, E. (1967). Application of operant conditioning procedures to the behavior problems of an autistic child: A follow-up and extension. *Behaviour Research and Therapy, 5*(2), 103–111. https://doi.org/10.1016/0005-7967(67)90004-6/
Wolf, M., Risley, T., & Mees, H. (1963). Application of operant conditioning procedures to the behaviour problems of an autistic child. *Behaviour Research and Therapy, 1*(2–4), 305–312. https://doi.org/10.1016/0005-7967(63)90045-7
Wright, P. I. (2019). Cultural humility in the practice of applied behavior analysis. *Behavior Analysis in Practice, 12*(4), 805–809. https://doi.org/10.1007/s40617-019-00343-8

2 Foundations of Applied Behavior Analysis

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Contents

Introduction

As described in Chap. 1, the science of behavior analysis broadly and discipline of applied behavior analysis (ABA) specifically have a rich history related to serving individuals with intellectual and developmental disabilities, including autism spectrum disorder (ASD; Ayllon & Michael, 1959; Baer et al., 1968; Fuller, 1949). Treatments and interventions based on ABA have taught and equipped individuals with ASD with the skills necessary to have improved qualities of life and means of communication, as well as increased independence (McConachie et al., 2018). Unlike other theories of learning, teaching, and intervention (e.g., cognitive learning theory, constructivism) that focus on unobservable events, ABA focuses on *environment–behavior relations*.

From a behavior-analytic perspective, *learning* occurs as a result of the *consequences* of

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one's *actions*. That is, the outcomes that result from a given behavior determine whether an individual will repeat them (see Thorndike's law of effect). The process through which consequences influence whether a behavior will or will not occur again in the future is *operant conditioning*. Operant conditioning is the underlying foundation of learning. Throughout this chapter, we describe relevant basic concepts and principles related to the foundations of ABA and operant conditioning as they relate to learning and instruction within the context of ASD.

Basic Concepts and Principles

In the following sections, we discuss basic concepts and principles most relevant to clinical practice with individuals with ASD. When applicable, we provide readers with both clinical and non-clinical examples.

Reinforcement

Reinforcement is frequently considered the most essential component when changing behavior. As a principle, it plays a key role in most behavior change programs designed and implemented by intervention agents (e.g., behavior analysts or technicians, teachers). Broadly, reinforcement refers to some change in the environment that immediately follows a response thereby increasing the future frequency or likelihood of that response. A stimulus change (i.e., addition or removal) that follows a response and is used to increase the occurrence of a response is a *reinforcer*. Note that *reinforcement* refers to the overall *process* through which the future frequency of a behavior increases; whereas a *reinforcer* refers to the *stimulus* that actually increases the future frequency of a behavior. If a stimulus is *added* to the environment (or increases in intensity) and increases the future frequency of the response it follows, that is *positive* reinforcement. If a stimulus is *removed* from the environment (or decreases in intensity) and increases the future frequency of the response it follows, that is *negative* reinforcement.

Positive Reinforcement

Positive reinforcement is the addition of a stimulus immediately following a response that increases the future frequency of that response. Put another way, *positive reinforcement* is when something follows a behavior that increases the likelihood the behavior will occur again in the future. Consider an example in which an instructor is running small-group circle time on a Friday morning. The instructor presents a weekly calendar and asks, "What day is it?" A student then answers, "Friday!" Afterward, the instructor says, "Yes, correct! It is Friday!" Assuming praise functions as a reinforcer, then on Fridays in the future when asked what day it is, that student is more likely to answer, "Friday." In another example, assume a child enjoys seeing her toy light up when she presses the toy's button. In the future, she is likely to press the button more often. Similarly, a child who receives praise every time they do the dishes is likely to do the dishes more often. In these examples, a response occurs (i.e., answering, "Friday," pressing a button, washing dishes) and a stimulus is presented that functions as a reinforcer (i.e., praise and fun lights). Thus, these are all examples of *positive reinforcement*.

Negative Reinforcement

The future frequency of a response can also increase because that response has led to the *removal* of a noxious or unpleasant stimulus (or a reduction in the unpleasantness). This is called *negative reinforcement*. *Negative reinforcement*, said another way, is increasing the future frequency of a response by the removal (or reduction) of an *aversive stimulus*. There are two types of contingencies under the broader umbrella of negative reinforcement: *escape* and *avoidance*.

Escape contingencies occur when a response results in the termination or removal of an aversive stimulus that was *already present in the environment* (e.g., Zangrillo et al., 2016). Note that an *escape contingency* would also refer to a situation in which a response results in the *reduction* in the aversiveness of a stimulus rather than its removal. For example, one's alarm clock may go off in the morning causing a loud ringing sound (an aversive stimulus). At this point, one would then likely hit the "snooze" button resulting in the termination of the ringing. Although this may only add 9 min of extra rest, the individual is likely to hit the "snooze" button in the future. This is an example of *negative reinforcement*.

An *avoidance contingency* describes a response being reinforced by its ability to enable the postponement or prevention of an aversive stimulus. A student eloping during a classroom circle time *escapes* the circle time that is ongoing and thus, the elopement is being negatively reinforced. Now in terms of avoidance, a student asks to go to the bathroom every day before circle time is meant to begin. The behavior of going to the bathroom is being reinforced, as it is allowing the student to *avoid* the upcoming circle time.

Negative reinforcement is often confused with punishment in nature. This is likely rooted in the history of the connotation of the terms *positive* and *negative*. It is important to remember that the term *reinforcement* always refers to the increase in the target response class. The descriptors positive and negative describe the type of stimulus change that is working as the consequence. We can associate the word *addition* with the descriptor *positive*, in which a stimulus is added to the environment. Likewise, we can associate the term *subtraction* with the descriptor *negative*, in which a stimulus is being subtracted (or removed) from the environment.

Unconditioned and Conditioned Reinforcers

When talking about stimulus changes that act as reinforcers, there are two types: unconditioned and conditioned. An *unconditioned reinforcer* refers to a stimulus change that can increase the future frequency of behavior without any prior pairing with another reinforcer. Examples of unconditioned reinforcers include food, water, and oxygen. Reinforcers that are unconditioned usually support the organism biologically. The effectiveness of these types of stimuli to function as unconditioned reinforcers is dependent on the organism's current state. For example, food is only reinforcing for an individual when they are food deprived, meaning they have not had anything to eat for a significant period of time.

Most behaviors that make up our daily lives are controlled by conditioned reinforcers. *Conditioned reinforcers* are stimulus changes that are established and function as reinforcers because of prior pairing with an unconditioned reinforcer or another conditioned reinforcer. Unlike unconditioned reinforcers, conditioned reinforcers are in no way related to the biological need of a species or organism. A conditioned reinforcer's ability to modify and shape behavior is a result of an individual's unique history of reinforcement (e.g., money). No two individuals will have the same history of reinforcement, and, thus, no two individuals will have the same set of conditioned reinforcers that function in the same manner. This is especially important to remember when working with individuals with ASD, as they can often have idiosyncratic reinforcer preferences, and, again, no two individuals will have the same set of or preference for reinforcers.

Punishment

Punishment describes when a response is followed immediately by a stimulus change that results in a decrease in future occurrences of similar responses. The terms positive and negative can also be used with punishment to describe the two types of stimulus changes, much like reinforcement. As is the case with reinforcement, the descriptors positive punishment and negative punishment only refer to whether the punishing consequence is being produced or withdrawn. *Positive punishment* decreases behavior through a response being immediately followed by the presentation of a punishing consequence, or aversive stimulus. Positive punishment is at play when you receive a paper cut, as the painful stimulation from the paper cut decreases the occurrence in the future of the behavior that came before the cut (e.g., filing papers quickly). In a clinical example, consider a child who begins jumping on a piece of furniture such as a couch. Here, a caregiver might provide a verbal reprimand, "No!" At this time, the individual ceases jumping and is less likely to jump on that piece of furniture in the future.

Negative punishment occurs when a response immediately followed by the removal of a stimulus decreases future occurrences of similar behaviors. For example, a child hits their sibling for yelling loudly for asking to borrow their tablet. Then, a caregiver immediately removes the tablet from the child who yelled. This removal of the tablet (stimulus) is acting as punishment for the child's behavior of hitting the sibling. Behavior interventions that involve negative punishment are usually contingent on the loss of an available reinforcer. A stimulus change can be referred to as a *punisher* when it decreases behavior when provided as a consequence following a response.

Like reinforcement, there are two types of punishers: unconditioned and conditioned. Examples of unconditioned punishers include painful stimulation, starvation, or extreme temperatures. A stimulus change can function as an *unconditioned punisher* when, following a response, it works to decrease future occurrences of similar responses, with no prior learning. For example, painful stimulation is an unconditioned reinforcer that decreases the behavior of walking barefoot outside after stepping on a rock previously causing a cut. These, however, do not control as many behaviors as do conditioned punishers. *Conditioned punishers* function as punishers because of pairing with another established unconditioned or conditioned punisher.

Punishment in Practice

Response interruption and redirection and *overcorrection* are just a couple of examples of common interventions that use positive punishment contingencies. A behavior analyst may implement an intervention for a child's throwing. Every time the child throws an item, they are instructed to practice picking the item up three times. This is an example of positive practice with overcorrection. Whereby the future frequency of the target behavior of throwing will hopefully decrease over time as a result of the presentation of an aversive stimulus (i.e., picking the item up several times).

Behavior analysts utilize two main tactics involving negative punishment to alter behavior: time-out and response cost. *Time-out* (i.e., time-out from positive reinforcement) involves the immediate removal of access to a reinforcer or the loss of opportunity to gain access to reinforcers. Time-out is only effective as a negative punishment tactic when it works to decrease the future occurrence of the behavior. Procedurally, time-out involves removing the individual from a reinforcing environment, or simply denying access to reinforcers within their current environment.

Although effective punishment tactics can produce lasting reductions to problem behavior, punishment is limited in clinical settings. Lerman and Vorndran (2002) outline the conditions that should be met before using an intervention featuring punishment over an intervention featuring reinforcement. Punishment is suitable when problem behavior must be reduced rapidly, interventions based in reinforcement have not worked previously, and/or a maintaining reinforcer cannot be identified or ethically withheld. Additionally, these authors describe factors that can influence the effectiveness of punishment as a treatment: history of the behavior and reinforcement, reinforcement schedules, the procedure of the punishment tactic, and alternative reinforcement sources that the child may have. It is important to note that punishment can also lead to undesirable side effects like emotional/aggressive responses, escape/avoidance behaviors, or even overuse of punishment by caregivers. Like reinforcement, punishment is a vital principle of learning behavior, but it should be implemented carefully in clinical environments.

Extinction

When an individual has encountered reinforcement after demonstrating a behavior, it increases the likelihood of it occurring again in the future. However, when a behavior is no longer reinforced it decreases the frequency of that behavior happening in the future. The cessation of providing reinforcement for a behavior is called *extinc-*

tion. Extinction occurs when reinforcement of a previously reinforced behavior is eliminated. It is important to note that extinction does not stop behavior from occurring. Rather, it changes the environment in a way that emitting the behavior no longer produces reinforcement.

Extinction is not simply "ignoring the behavior," although planned ignoring may be useful if dealing with an attention-maintained behavior. It is essential that the function of the problem behavior is taken into consideration when withholding reinforcement. If a child's problem behavior is maintained by adult attention, "planned ignoring" may be an appropriate option for placing that attention-maintained behavior on extinction. In turn, the probability of that behavior occurring in the future will be reduced over time. However, if the function of the child's behavior is escape, ignoring the behavior would not be effective at reducing the behavior. Instead of planned ignoring, when a child flops on the floor to escape a demand, continuing to place the demand or tasks would make the problem behavior ineffective in avoiding the task. Behaviors maintained by negative reinforcement are only placed on extinction when those behaviors do not result in the removal of the demand or task (Cooper et al., 2019).

When implementing an extinction procedure, there may be an immediate increase in the frequency and/or magnitude of the problem behavior, which is referred to as an *extinction burst*. Although extinction bursts may be challenging for technicians or parents to experience, they are typically short lived if the correct function is being targeted. Extinction bursts can be a sign that the correct reinforcer maintaining the problem was identified and increase the likelihood of success with extinction. Another factor to consider when implementing extinction is the possibility for spontaneous recovery. *Spontaneous recovery* occurs when the behavior that is placed on extinction occurs again, even though the behavior has not come into contact with reinforcement. If the extinction procedure maintains, the behavior will likely disappear.

Resistance to extinction can contribute to the success of the behavior reduction procedure. Schedules of reinforcement can impact how soon extinction is effective for individuals. If the behavior had been reinforced by an intermittent schedule of reinforcement or a particularly thin schedule of reinforcement, it may be more resistant to the effects of extinction. This means that if the individual had fewer occurrences of reinforcement prior to the extinction procedure, it may take longer for the behavior to reduce (Cooper et al., 2019). Another factor to consider in the resistance to extinction is the history of reinforcement for that behavior. If an individual has had a long history of reinforcement for the problem behavior, it may be more resistant to extinction compared to a behavior with a shorter reinforcement history. A child whose tantrums had been reinforced over several years may take more time to see decreases in frequency compared to a child whose behavior had only been reinforced for a few weeks.

Extinction should not be implemented in isolation. A behavior should not be reduced without simultaneously teaching the individual an appropriate replacement behavior. For example, if an individual hits to get the teacher's attention, a functional communication program in addition to extinction should provide the learner with an appropriate replacement behavior to gain attention while reducing the unwanted response. When considering what behavior to use as a replacement, the instructor should ensure the replacement behavior requires less response effort than the problem behavior. A high-effort response will decrease quickly when compared to one that requires little effort to obtain reinforcement. This is an important consideration to keep in mind when developing a treatment package for individuals with ASD.

One important element to the successful implementation of extinction is the interventionist. When developing an individual's extinction plan, it is important to take into consideration the various environments and contexts that the behavior occurs in as well as the skill of the individuals implementing the protocol. If there is miscommunication or inconsistency regarding what behaviors are on extinction, there is an increased possibility of inadvertently reinforcing the problem behavior and increasing the chance of it becoming more resistant to extinction. It is also important to note that extinction should not be used on behaviors that may be dangerous to the individual or others. For example, severe self-injurious behaviors or aggression is not a fit for an extinction procedure, as not intervening could result in injury. In instances where extinction cannot be used safely, other procedures or interventions should be utilized.

Chaining

A *behavior chain* (or simply chain) is a complex behavior consisting of many smaller *component* behaviors that occur together in a sequence (Miltenberger, 2008). The result of a chain produces a terminal consequence or outcome (e.g., clean hands from scrubbing in before surgery). Following the presence of an establishing operation (e.g., dirty hands) and discriminative stimulus (e.g., sink and soap), the behavior chain begins. Each response within the behavior chain produces a stimulus change that serves as a conditioned reinforcer for that response and functions as a discriminative stimulus for the next response in the sequence or chain. The only exception to this relationship between responses is the first and final behavior in the chain. The terminal consequence in the behavior chain provides reinforcement that is effective in maintaining the stimulus changes produced by the previous responses. Each behavior within the chain has a clear beginning and end and each response must be completed correctly.

Individuals often engage in behavior chains so quickly and fluently that the chain often appears as a simple, singular response. For example, the complex behavior of "putting on a shoe" consists of the component behaviors of (1) picking up the shoe, (2) sliding it over the correct foot, (3) grabbing the laces, (4) crossing the laces, (5) creating the knot (viz., "loop, swoop, and pull," or "bunny ears" technique), and (6) completing the knot. At first glance, "putting on a shoe" might seem trivial or simple. However, as readers can see, there are several smaller steps that go into "putting on a shoe"—this is an example of a behavior chain. Further note how each of those steps must be completed in the *specific order* for the shoe to be put on correctly.

When specific sequences of stimuli and responses are linked, they form a new response. Instructors use *chaining* to break down complex skills into smaller tasks while the learner responds with increased independence on each task over time. This instructional strategy can be used to add behaviors to repertoires that already exist or can allow for simpler tasks to be combined into more complex series of responses. Also, behavior analysts can use chaining techniques to adapt known tasks into more intricate repertoires.

Chaining procedures are most often used in teaching a more complex behavior within a *task analysis*. A *task analysis* is used to break more complex behaviors or tasks into smaller, more easily teachable steps. First, the instructor should identify the sequence of behaviors necessary to complete the behavior. The client's current skill set and baseline performance should be taken into consideration, as well as the client's age, and prior experience will help guide the development of the task analysis. An example of a task analysis for handwashing might include (1) turn on water, (2) place hands under water, (3) put soap on hands, (4) rub hands together for 20 s, (5) place hands under water until soap is gone, (6) turn off water, (7) grab paper towel, (8) dry hands, and (9) throw paper towel away. Although this task analysis may work in some environments and with some clients, there may be steps that need adjustment based on the client or environment. Some bathrooms use hand towels or air dryers, and some sinks are automatic and there is nothing to "turn on." Also, the step, "put soap on hands" may need to be broken down further to include (1) place right hand under soap dispenser and (2) use left hand to push the soap button. When developing a task analysis, pinpointing the specific steps that need to be adjusted will help during the teaching process. In other words, task analyses can be flexible and may need to change based on an individual's current environment and will not be ubiquitous across all settings.

There are three primary chaining procedures that can be used to teach each step in the task analysis: forward chaining, backward chaining, and total-task chaining. When using *forward chaining*, the first step in a task analysis is taught to the learner until they can conduct it independently. Then each step following is taught in succession. Continuing from the handwashing example, in forward chaining the client is taught to turn the water on first and once they show independence with that skill, they are taught to rinse their hands. *Backward chaining* is the opposite of forward chaining in which the instructor completes all the tasks in the chain except for the final behavior, which is where the teaching begins. Once the learner completes the final behavior independently, new steps are taught in descending order. When teaching handwashing using backward chaining, the instructor will conduct all steps of the handwashing procedure but teach them to independently throw their paper towel away (the final step in the chain). Once this step is mastered, the learner is taught to independently dry their hands before throwing the paper towel away. This process continues in descending order until all steps are completed independently. *Total-task chaining*, also termed *total-task presentation*, is a variation of forward chaining in which every step in the task analysis is performed by the learner. The instructor provides prompting for steps that are performed incorrectly, and mastery is met once all steps can be completed independently. In any case, choosing the correct chaining method is dependent on the learner and the skill being taught.

Feedback

Behavior can be shaped over time with feedback. *Feedback* is specific information that an individual receives after completion of a behavior. Feedback guides behavior by providing learners with behavior-specific descriptions of their performance or actions. This should not be confused with praise, which is a form of positive reinforcement that results in an increased frequency of responding. Although feedback may increase future responding, corrective feedback can serve as a prompt or guide regarding how to respond differently. Said another way, feedback can function as either a reinforcer or punisher depending on the correctness of the behavior emitted and the form and function of the feedback. Broadly speaking, feedback includes mention of a specific behavior, the impact of that behavior, and the desired future behavior.

When a learner is taught a new skill or engages in a desired behavior, providing verbal feedback can be a form of reinforcement. For example, telling a student, “Good job, matching the dog!” provided the learner with positive reinforcement for their behavior of matching as well as behavior-specific guidance on how they should respond in the future when presented with this task. Feedback can also be a corrective method to change behavior by providing the learner with alternative actions that would assist in their performance of the task or skill. This can result in a reduction of some aspect of the learner’s performance as a function of punishment or instruction (Cooper et al., 2019).

Not all feedback is meaningful or effective at shaping future behavior. Hattie and Timperley (2007) outline the criteria for effective, meaningful feedback to inform the learner of the goal, the progress being made toward the goal, and what activities need to be undertaken to make better progress. Meaningful feedback allows the learner to bridge the gap between their current behavior and where it is expected to be in the future. When the goal is clear, and there is an apparent high probability of success in the future, the learner is more likely to increase their performance and seek improvement (Daniels, 2016).

Feedback has also proven to be more effective when given immediately. Opitz et al. (2011) found that feedback immediately provided following a response was more effective at increasing performance, when compared to providing delayed feedback. Scheeler et al. (2010) compared immediate and delayed feedback provided via bug in the ear on a teacher’s ability to correct teaching strategies in vivo. Compared to delayed feedback, the teacher’s behavior improved significantly faster and maintained over time during the immediate feedback phase. Immediate corrective feedback should also be used to increase the accuracy of student performance. When a student answers or performs a task incorrectly, using immediate corrective feedback can help reduce the likelihood that the individual will engage in that same behavior.

Shaping

When teaching complex behaviors, interventionists may consider first starting by teaching behaviors in sections or smaller, more attainable goals through shaping. *Shaping* is defined as the "differential reinforcement of successive approximations toward a terminal behavior" (Cooper et al., 2019, p. 541). In this sense, *differential reinforcement* refers to presenting a reinforcer only to behaviors that are a part of the same response class and share a specified quality (Cooper et al., 2019) while other behaviors outside that response class are placed on extinction.

Shaping can be used for a wide variety of behaviors and situations. Hodges et al. (2021) used shaping to help increase feeding in children with ASD by systematically increasing the variety of foods for individuals who demonstrated feeding rigidity. When using shaping via hierarchical exposure, all individuals involved with the study were successful at accepting and eating the target foods.

When implementing a shaping procedure, an analyst must first determine what slight change in responses is likely to progress toward the terminal behavior. Those responses will then be differentially reinforced and will increase the probability of the individual emitting the closer approximation in the future. For example, when a child is born, they are unable to move without assistance from a parent or caregiver. As the child ages, they begin to learn how to crawl, then stand, take one or two steps, until finally, they can walk. You can see shaping when parents praise the child for crawling, then praise when the child stands or takes its first step, and so on.

Shaping is often combined with other interventions or behavior change procedures (Cooper et al., 2019). Kahveci and Serin (2019) utilized shaping protocols along with non-aversive communication teaching techniques to reshape vocal stereotypy in individuals with ASD. Combining these techniques, the therapist was able to shape the vocal stereotypy exhibited by participants into more functional vocalizations. Shaping can also be combined with chaining procedures when behaviors within the chain may be underdeveloped. For example, if an analyst is having difficulties teaching a child a specific step of a task analysis, shaping can be used to teach various approximations of that step, working back up to the initial target behavior.

Although there are many positives to using a shaping procedure in the clinical setting, there are a few limitations that need to be addressed. First, shaping new behaviors can often take a long time and can require multiple approximations before the desired behavior is reached. Shaping also requires continued vigilance from the analyst to be able to detect even the smallest changes in performance from the child. If choosing to implement a shaping procedure, the analyst and those working with the child must be constantly analyzing the child's performance and noting any changes in the response topography of the behavior. Drifting from the procedures can inadvertently cause reinforcement of other, undesired behaviors.

Pryor's *The Modern Principles of Shaping* provide analysts with a set of guidelines to consider when considering a shaping procedure. The first guideline is to be prepared. In order for shaping to be effective, immediate reinforcement of every positive approximation is crucial. Having all materials prepped and ready will help the shaping process run more smoothly. Analysts also need to make sure that each step of the behavior is broken down to a level where success is ensured. Shaping is not linear; if one style or method of shaping is not giving the desired results, try a different way and make changes based on the data the interventionist is obtaining. Finally, the analyst should evaluate the nature of the behaviors being learned as well as if they have the staff and resources to provide consistent implementation. Some behaviors may benefit from other forms of intervention such as prompting, modeling, or peer-tutoring. If the interventionist is unable to monitor the behavior effectively, another procedure may be a better fit and more time effective.

Graduated Guidance and Modeling

Teaching individuals a new skill requires some form of prompting from the instructor. Some common forms of prompting include most-to-least, least-to-most, and graduated guidance. These prompting methods are used to transfer stimulus control from contrived response prompts to naturally occurring stimuli. Most-to-least prompting involves the analyst physically guiding the learner through the entire sequence of tasks then gradually reducing the amount of physical guidance provided as the learner performs the skill. Least-to-most prompts allow the learner the opportunity to perform the skill with the least amount of prompting (e.g., gesture or verbal prompt) from the analyst that results in completion of the skill. Individual learner characteristics should be taken into consideration before making a decision which prompting hierarchy to use.

Modeling is a strategy that allows for a learner to acquire new skills through imitating the actions or sequences performed by others (Cooper et al., 2019). When using modeling as a teaching strategy, the instructor will demonstrate exactly what skills the learner is expected to perform. However, before this strategy can be effective, the learner must be able to imitate others and attend to the model. When a live model is not appropriate (e.g., model of how to get dressed), *video modeling* provides a viable alternative. This variation of traditional modeling involves learners watching a recorded video of a skill rather than a live model (Bellini & Akullian, 2007). Akmanoglu et al. (2014) found video modeling to be an effective method in teaching individuals with ASD communication and social skills. In this study, individuals were taught role playing skills related to various activities by watching video models of appropriate interactions between peers.

Combining modeling with verbal or written instruction has shown to enhance or improve an individual's ability to perform a skill. Bovi et al. (2016) used video modeling combined with voice over instructions to teach staff at a public school to implement a preference assessment. Although combining modeling with verbal prompting can be effective, providing learners with multiple opportunities to respond as well as providing feedback regarding their performance will increase the effectiveness of the training. Through skill practice, the instructor can more accurately see the progress and determine if changes or additional prompting need to be incorporated.

A teaching technique in behavior analysis that incorporates both physical prompting and modeling is graduate guidance. *Graduated guidance* is often utilized for skills within a behavior chain (Neitzel & Wolery, 2009) by providing the necessary level of prompting to ensure success then quickly fading the prompt until the individual completes the skill independently. For example, the instructor started with hand over hand physical guidance to prompt a child to turn on the sink when washing hands. Over time, they reduce the prompt by gently guiding the child's elbow, then shoulder, until no physical guidance was needed. By remaining close to the child, the instructor can physically prompt if necessary.

Summary

In this chapter, we provided an overview and introduction of learning from a behavior-analytic perspective, how ABA is used within the treatment of individuals with ASD, and basic concepts and principles that are fundamental to developing said treatments. These concepts and principles are by no means exhaustive. However, they are several of the *primary concepts* underlying operant conditioning, learning, and treatment for individuals with ASD. We encourage readers to refer back to these sections as they peruse the upcoming chapters in this book to draw further connections between these basic concepts and how they play into other aspects of treatment for individuals with ASD (e.g., assessment, challenging behavior, adaptive and self-help skills).

References

Akmanoglu, N., Yanardag, M., & Batu, E. S. (2014). Comparing video modeling and graduated guidance together and video modeling alone for teaching role playing skills to children with autism. *Education and Training in Autism and Developmental Disabilities, 49*(1), 17–31. http://www.jstor.org/stable/23880652

Ayllon, T., & Michael, J. (1959). The psychiatric nurse as a behavioral engineer. *Journal of the Experimental Analysis of Behavior, 2*(4), 323–334. https://doi.org/10.1901/jeab.1959.2-323

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Bellini, S., & Akullian, J. (2007). A meta-analysis of video modeling and video self-monitoring interventions for children and adolescents with autism spectrum disorders. *Exceptional Children, 73*(3), 264–287. https://doi.org/10.1177/001440290707300301

Bovi, G. M., Vladescu, J. C., DeBar, R. M., Carroll, R. A., & Sarokoff, R. A. (2016). Using video modeling with voice-over instruction to train public school staff to implement a preference assessment. *Behavior Analysis in Practice, 10*(1), 72–76. https://doi.org/10.1007/s40617-016-0135-y

Cooper, J. O., Heron, T. E., & Heward, W. L. (2019). *Applied behavior analysis* (3rd ed.). Pearson Education.

Daniels, A. (2016). *Bringing out the best in people: How to apply the astonishing power of positive reinforcement* (3rd ed.). McGraw Hill Education.

Fuller, P. R. (1949). Operant conditioning of a vegetative human organism. *The American Journal of Psychology, 62*(4), 587–590.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112. https://doi.org/10.3102/003465430298487

Hodges, A., Phipps, L., & Crandall, M. (2021). Using shaping to increase foods consumed by children with autism. *Encyclopedia of Autism Spectrum Disorders*, 4981–4984. https://doi.org/10.1007/978-3-319-91280-6_102385

Kahveci, G., & Serin, N. B. (2019). Shaping vocal stereotypy in autism spectrum disorder: A non-aversive communication teaching technique. *Universal Journal of Educational Research, 7*(6), 1448–1457. https://doi.org/10.13189/ujer.2019.070612

Lerman, D. C., & Vorndran, C. M. (2002). On the status of knowledge for using punishment: Implications for treating behavior disorders. *Journal of Applied Behavior Analysis, 35*(4), 431–464. https://doi.org/10.1901/jaba.2002.35-431

McConachie, H., Mason, D., Parr, J. R., Garland, D., Wilson, C., & Rodgers, J. (2018). Enhancing the validity of a quality of life measure for autistic people. *Journal of Autism and Developmental Disorders, 48*, 1596–1611. https://doi.org/10.1007/s108803-017-3402-z

Miltenberger, R. G. (2008). *Behavior modification: Principles and procedures* (4th ed.). Thompson Wadsworth.

Neitzel, J., & Wolery, M. (2009). *Steps for implementation: Graduated guidance*. The National Professional Development Center on Autism Spectrum Disorders, FPG Child Development Institute, The University of North Carolina.

Opitz, B., Ferdinand, N. K., & Mecklinger, A. (2011). Timing matters: The impact of immediate and delayed feedback on artificial language learning. *Frontiers in Human Neuroscience, 5*(8), 1–9. https://doi.org/10.3389/fnhum.2011.00008

Scheeler, M. C., Congdon, M., & Stansbery, S. (2010). Providing immediate feedback to co-teachers through bug-in-ear technology: An effective method of peer coaching in inclusion classrooms. *Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children, 33*(1), 83–96. https://doi.org/10.1177/0888406409357013

Zangrillo, A. N., Fisher, W. W., Greer, B. D., & Owen, T. M. (2016). Treatment of escape-maintained challenging behavior using chained schedules: An evaluation of the effects of thinning positive plus negative reinforcement during functional communication training. *International Journal of Developmental Disabilities, 62*(3), 147–156. https://doi.org/10.1080/20473869.2016.1176308

3 Applied Behavior Analysis and Its Application to Autism and Autism-Related Disorders

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Introduction

The prevalence of autism spectrum disorder (ASD) in the United States continues to rise, with currently 1 in 44 children under the age of 8 years carrying the diagnosis (Maenner et al., 2021). This increased prevalence has been accompanied

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by research aimed at identifying the etiology of ASD, improving assessment approaches, and developing interventions that address its defining behavioral characteristics. These characteristics in children include delays in verbal and nonverbal forms of communication, difficulties with social initiation and responsiveness, reduced creative and imaginative play, and interfering behaviors including inflexible adherence to specific routines, repetitive speech, and atypical sensory reactions. Additional developmental challenges in adulthood include a history of difficulties developing and maintaining friendships and relationships and navigating social expectations in work and other settings. From a behavioral standpoint, the expression of ASD can be grossly categorized as including (1) behaviors of excess like repetitive behavior and certain challenging behaviors such as aggression and self-injurious behavior (SIB) and (2) behaviors of deficit such as delays in the areas of communication, peer relations, and academic and independent functioning. For several decades, researchers and clinicians have worked to identify behavioral interventions to address these categories of behavior when they have posed barriers to individual functioning.

Applied behavior analysis (ABA), and its role in clinical services for autistics/individuals diagnosed with autism spectrum disorder (ASD), is perhaps most well known due to the work of Ivar Lovaas that began in the 1970s when he developed an approach to discrete trial teaching (DTT) he termed "applied behavior analysis." However, it must be noted that Lovaas's use of the term "applied behavior analysis" does not represent, and should not be confused with, the totality of what constitutes ABA. This chapter focuses on interventions based in the science of ABA. Lovaas's work and indeed the progression of DTT-based interventions that emerged from it are discussed as a part of this work but are not the focus of the chapter. The chapter begins by providing an overview of ABA, including its basic foundations and a discussion of relevant terms and concepts. Several examples from the scientific literature will be described to illustrate how ABA-based interventions have been used to evaluate and intervene on behaviors that pose barriers to functioning experienced by individuals with autism/autistic individuals. At the conclusion of the chapter, we will briefly discuss current developments and future directions in the application of ABA-based interventions for autistics/individuals diagnosed with ASD.

In-depth coverage of each of the topics will not be possible given the space limitations of a chapter. Readers are encouraged to independently delve further into the literature, using the cited studies, texts, and chapters referenced in the following pages.

Conceptual Basis and Foundation of Applied Behavior Analysis

Applied behavior analysis as a science was established in the early second half of the twentieth century as an approach to evaluate and change human behavior based on operant conditioning. Operant conditioning can be defined as the process through which the environment and behavior interact to shape the behavioral repertoire of an organism or individual (Skinner, 1953). By 1968, ABA had gained enough of a following in the scientific community that a journal was established (*Journal of Applied Behavior Analysis* or *JABA*) to publish empirical studies related to the applied behavior analysis of human responding. Baer et al. (1968) provided a thorough description of this emerging science, including details related to its defining characteristics of ABA. Three minimally defining characteristics of ABA were obvious: applied, behavioral, and analytic. Four other defining features were also suggested by Baer et al. Specifically, ABA should be technological, conceptually systematic, effective, and "display some generality" (p. 92).

In the behavioral context, Baer et al. (1968) established the term *applied* to mean that the behavior or stimulus addressed was chosen because of its importance to humankind and society, rather than its importance to theory. *Behavioral* means that the focus should be on what individuals can be brought to do, rather than what they can be brought to say (Baer et al., 1968). *Analytic* refers to the notion that ABA requires a believable demonstration of the events responsible for the behavior. An analysis of behavior has been achieved when an experimenter (scientist, parent, teacher, care provider) can exercise control over the behavior (Baer et al., 1968).

Beyond defining the three core terms of ABA, Baer et al. (1968) noted additional dimensions of the science, including: technological, conceptually systematic, and effective. ABA's emphasis on being *technological* means that the "techniques making up a particular behavioral application are completely identified and described" (p. 95). This characteristic is an attempt to ensure that examples of ABA can be reliably replicated by those reading the account (Baer et al., 1968). Given the replication crisis that exists within the broader field of psychology, this dimension of ABA has renewed importance.

Conceptually systematic highlights ABA's relevance to principle. This characteristic is meant to tie the technological descriptions to basic principles of behavior analysis. For example, Baer et al. (1968) suggested that describing "exactly how a preschool teacher will attend to jungle-gym climbing in a child frightened by heights is good technological description; but further to call it a social reinforcement procedure relates it to basic concepts of behavioral development" (p. 96).

ABA should also be *effective*. That is, the behavioral techniques should produce large enough effects to be of practical value (Baer et al., 1968). In addition, the behavior change resulting from ABA should be durable over time, across a variety of settings, and/or spread to related behavior.

These characteristics help to define ABA as a methodology that can be used to select, change, and evaluate human behavior. It is important to note that, in the context of this chapter, ABA does not refer to a specific package designed to address the challenges of autism spectrum disorders. Rather, ABA refers to the conceptual and scientific framework upon which a wide variety of intervention strategies and packages are based. Thus, the science of ABA provides a foundation for numerous approaches to behavior change relevant to a wide range of individuals, from neurotypical to those with intellectual disability and mental health concerns, as well as individuals with ASD/autistic individuals. In the following sections of this chapter, we will define and describe the concepts that underlie these approaches and review their use with autistics/individuals diagnosed with ASD.

Concepts and Application

Several treatments have been identified that address the social, communicative, and behavioral deficits and excesses exhibited by many autistics/individuals diagnosed with ASD. Steinbrenner et al. (2020), along with the Frank Porter Graham Institute at the University of North Carolina, published a document updating previously identified evidence-based practices (EBPs) to address behavioral challenges experienced by individuals with autism. Based on their review of the published literature, Steinbrenner et al. identified 28 evidence-based practices. Some of these practices, such as Functional Behavioral Assessment (FBA), are not interventions, per se, but approaches to assist in the intervention design for challenging behavior. Other EBPs, such as Augmentative and Alternative Communication (AAC), describe response or technology alternatives that can be helpful. Still other practices, such as Cognitive Behavioral/Instruction Strategies (CBIS), derive from conceptual orientations outside of ABA. However, large proportions of the EBPs identified are rooted in behavior analytic theory and derive their demonstration of efficacy from the applied behavior analytic literature. In this section, several of the ABA concepts upon which those EBPs are based will be defined and discussed. These concepts, along with treatment examples from the literature, have been separated into consequence-based and antecedent-based approaches. In addition, combined treatments (e.g., one antecedent and one consequence, or two or more of each), as well as a brief description of some packaged approaches, will be reviewed.

Consequence: Reinforcement and Reinforcement-Based Procedures

Reinforcement can be defined by its effect on behavior. Specifically, reinforcement refers to the response-dependent presentation (positive reinforcement) or removal (negative reinforcement) of a stimulus resulting in an increased likelihood of responding (Skinner, 1953). With the emergence of assessment technologies designed to reliably identify stimulus preferences and reinforcers instrumental in the maintenance of appropriate and inappropriate behavior, reinforcement programs are the foundation for interventions that address the behavioral deficits and excesses experienced by individuals with ASD/autistic individuals. Reinforcement forms the foundation for a variety of procedures identified as EBPs. Within these programs, reinforcers can be delivered immediately following a response, intermittently following fixed or varied numbers of responses, or following specific time parameters (e.g., the first response following 60 s; the reader is directed to Ferster and Skinner (1957), for a comprehensive description of various reinforcement schedules). Alternatively, the reinforcers can be delivered in a delayed fashion with a token, or other icon, used to help bridge the temporal gap between response and reinforcement (i.e., a token economy). Finally, single responses can be targeted for increase (e.g., exhibiting a particular communicative response), complex responses can be targeted for increase (e.g., reading), or a series of approximations toward a final response goal (i.e., shaping) or a series of interconnected discrete responses (i.e., chaining) can be targeted. Within the context of interventions for individuals with ASD/autistic individuals, clinical issues targeted by reinforcement procedures include appropriate communication, social interactions, and other academic, vocational, and independent living skills.

While reinforcement provides the basis for many EBPs, it is rarely, if ever, the sole component of intervention. For that reason, examples of positive and/or negative reinforcement as singular approaches to treatment will not be provided (though Steinbrenner et al., 2020, list "reinforcement" individually as an EBP). Instead, the application of positive and negative reinforcement will be discussed within the context of other reinforcement-based interventions including token economies and differential reinforcement (DR). In the following subsections, the EBPs that make use of reinforcement contingencies will be reviewed. These approaches include token economies, differential reinforcement (including functional communication training [FCT]), and behavioral momentum intervention.

Token Economy

Token economies refer to the delivery of a conditioned reinforcer that can later be exchanged for another reinforcer. Typical conditioned reinforcers include points, stickers, or other stimuli that can be easily delivered and held for later exchange. This type of reinforcement system has several advantages, including some resistance to satiation effects, ease of implementation in large-group settings, and, in such settings, the ability to use uniform reinforcers for several individuals (Rusch et al., 1988). Cooper et al. (2019) defined three components of a token economy: (1) A list of target responses, (2) tokens or points to be earned, and (3) a menu of items for which tokens and/or points can be exchanged. Tokens typically do not have any particular value in and of themselves; their reinforcing value comes from the opportunity to exchange them for other, more salient reinforcers (Rusch et al., 1988).

As with many evidence-based practices, recent research related to token economies has shifted from demonstrating efficacy to evaluating intervention variables that lead to better outcomes or demonstrating efficacy across functional classes of problem behavior. Sleiman et al. (2020) evaluated the differential impact of token manipulation (student versus instructor) on performance in an academic context of students with ASD/autistic students. Results demonstrated idiosyncratic outcomes for both performance (one student's performance was better in the student-manipulated condition, the other two demonstrated no difference) and preference (two students preferred the student-manipulated context, the other demonstrated no preference).

Cihon et al. (2019) evaluated the effects of a flexible earning requirement on the efficacy for token economies implemented with three autistic students/students diagnosed with ASD as an intervention for increasing social interactions (e.g., comments made during snack times). Often, token economies operate using a fixed exchange schedule (e.g., after five tokens are earned, they can be exchanged for the back-up reinforcer) known to the individual. Cihon et al. evaluated a flexible exchange schedule within a nonconcurrent multiple baseline and demonstrated that this arrangement produced increases in the target response, as well as an increase in response novelty.

Along with evaluating procedural variations, other researchers have demonstrated the efficacy of token economies as a component of non-extinction-based interventions to reduce escape-maintained problem behavior. Andzik et al. (2022) implemented an intervention during academic instruction to address the escape-maintained problem behavior exhibited by four autistic students/students diagnosed with ASD. The intervention included two components: (a) a brief break (30 s) from task contingent on problem behavior, and (b) delivery of a token contingent on compliance. Tokens were exchanged at the end of the instructional session for time (10 s for each token earned) with preferred items/activities. Results of the evaluation indicated that problem behavior decreased and compliance increased across the four participants. This finding is potentially impactful as it allows practitioners to add to their toolbox of interventions approaches that do not include procedures such as escape extinction.

Differential Reinforcement

Differential reinforcement procedures are consequence-based procedures that include two key components: (1) reinforcement of one response(s) and (2) extinction or withholding of reinforcement for a separate response(s) (Cooper et al., 2019; note: extinction will be discussed later in this chapter). In application, the response(s) targeted for reinforcement includes appropriate behavior while the response(s) targeted for extinction includes inappropriate behavior (though exceptions can be found). There are a number of differential reinforcement strategies that have been used to address behavioral challenges experienced by individuals with ASD/autistic individuals.

Differential Reinforcement of Alternative Behavior Perhaps the most frequently applied differential reinforcement strategy is differential reinforcement of alternative behavior (DRA). When applied as an intervention to address challenging behavior (i.e., behavioral excess that puts the person or others at risk and/or interferes with social, educational, or vocational functioning), the procedure includes extinction for the target inappropriate or undesired response and contingent delivery of reinforcers following an appropriate response alternative. Reinforcer selection is often based on a pre-treatment assessment designed to identify the function of the inappropriate or undesired response (e.g., an analogue functional analysis; Iwata et al., 1994 [1982]). The selected alternative response can vary and might include responses such as compliance (Romani et al., 2016) or communication (i.e., functional communication training [FCT], Carr & Durand, 1985). Incorporating appropriate communicative responding into DRA programs is formally known as functional communication training (FCT). FCT has emerged as one of the most frequently researched applied interventions to reduce challenging behavior such as aggression and SIB experienced by individuals with developmental disabilities (Tiger et al., 2008) and is noted by Steinbrenner as its own approach to EBP. In an FCT program, the reinforcer maintaining challenging behavior is identified. Then, an appropriate communicative alternative is identified. Finally, the individual is exposed to the situations that evoke problem behavior. Appropriate responding is prompted and differentially reinforced, with prompts being faded. Appropriate communicative responses can vary and have included simple gestures such as reaching (Grow et al., 2008), the use of augmentative communication devices (Ringdahl et al., 2018), manual sign (Shirley et al., 1997), spoken or vocal responses (Carr & Durand, 1985), or starting with one communication response and transitioning to another (Randall et al., 2021).

DRA-based interventions can incorporate either positive or negative reinforcement contingencies. For example, Schlichenmeyer et al. (2015) identified access to tangible items (i.e., positive reinforcement) as the maintaining function of SIB exhibited by one autistic/individual diagnosed with ASD. Their DRA procedure incorporated the communicative response (i.e., FCT) of touching a relevant icon (e.g., "bubbles") on a communication device, while SIB resulted in extinction (i.e., the stimulus was withheld following occurrences of SIB). The investigators were able to add additional response requirements into the DRA (e.g., simple work tasks completed between initial request and delivery of the reinforcer) and demonstrated efficacy across implementers.

Romani et al. (2016) employed a negative-reinforcement-based DRA procedure to decrease the escape-maintained challenging behavior exhibited by three autistic students/students diagnosed with ASD. In their study, cooperation with completing tasks resulted in brief breaks, while the previous relation between challenging behavior and escape from tasks was disrupted via extinction. Each student demonstrated a decrease in challenging behavior and an increase in cooperation with tasks.

Similar to research related to other applied behavior analytic interventions, demonstrations of efficacy such as those reported by Charlop et al. (1990) have given way to investigations of strategies to make DRA more practical and identify variables that might affect long-term maintenance of treatment effects. The previously described Schlichenmeyer et al. (2015) study provides an illustration of one direction DRA-related research has gone in recent years (i.e., increasing the complexity and practicality of the intervention). Another recent direction of DRA-related research focuses on long-term maintenance of intervention effects. For example, Fisher et al. (2018) evaluated the impact of lean reinforcement schedules implemented over a long time relative to dense reinforcement schedules implemented over a short time. Results of this investigation, conducted in the context of intervention for challenging behavior exhibited by autistic individuals with ASD diagnoses, demonstrated that longer, leaner schedules mitigated relapse of challenging behavior relative to shorter, denser schedules. Similarly, the previously described study by Romani et al. (2016) included an investigation of the impact of reinforcement rate on the maintenance of DRA-based interventions. Results of that portion of the study demonstrated that higher rates of reinforcement produced appropriate behavior that was more persistent when intervention was disrupted with extinction. Collectively, these studies provide practitioners with information related to how interventions can be constructed such that the initial intervention gains can be maintained over time, or disruptions to optimal implementation are encountered in real-world settings.

Typically, DRA-based interventions include an extinction component for problem behavior. As reported by Hagopian et al. (1998), this arrangement, specifically when considering the DRA-based intervention of FCT, yields the greatest clinical impact. However, a recent trend in research and application of DRA schedules has focused on arrangements in which both appropriate and inappropriate behaviors result in programmed reinforcers. This arrangement is termed DRA without extinction and the reader is directed to two relevant discussion pieces related to the topic (van Haaren, 2017; Vollmer et al., 2020).

Athens and Vollmer (2010) provided several of this schedule arrangement in application to address the challenging behavior exhibited by seven children with developmental disabilities (including six autistic children/children diagnosed with ASD). Interventions varied with respect to the consequences for appropriate and challenging behavior along the dimensions of duration, quality, or delay of reinforcement (or some combination). Results of this study demonstrated combinations that favored appropriate behavior resulted in responses being allocated toward appropriate behavior and away from problem behavior, allowing for successful intervention in the absence of extinction. Trump et al. (2020) provided a literature review of 32 articles that implemented this type of intervention arrangement. The majority of the studies described in these articles (68%) yielded positive effects. Thus, the approach appears to hold promise as an intervention for challenging behavior. Kunnavatana et al. (2018) evaluated response allocation exhibited by three individuals with various disabilities (including two individuals diagnosed with ASD) under concurrent schedule arrangements. Results of this study indicated that concurrent schedules could be used to identify individual sensitivity to reinforcer dimensions, which could allow for more precision when designing interventions.

Differential Reinforcement of Incompatible Behavior (DRI) Like FCT, DRI can also be considered a type of DRA. However, in a DRI procedure, the alternative response is specified as one incompatible with the target inappropriate response. For example, hands in pockets might be the incompatible response reinforced in the DRI-based treatment of self-injurious head hitting. By contrast, exhibiting the appropriate vocal response "help" is not physically incompatible with pinching the teacher. Wells et al. (2019) provided an example of this approach to intervention to reduce the dangerous elopement behavior exhibited by a 5-year-old girl diagnosed with ASD. Intervention targeted elopement exhibited during transitions from setting to setting (e.g., classroom to recess) at the participant's school. The specific intervention included delivery of an edible reinforcer on a fixed-interval 20-s schedule contingent on the student exhibiting incompatible behavior, defined as walking within approximately an arm's length of the accompanying adult. Results indicated a reduction in elopement across three transition types contiguous with intervention implementation within a multiple baseline across settings in the experimental design. In addition, the researchers were able to successfully begin the process of thinning the reinforcement schedule. Collectively, the low cost and easily implemented procedure resulted in the reduction of a potentially dangerous behavior exhibited by the student.

Differential Reinforcement of Low Rates Differential reinforcement of low rates of behavior (DRL) is a reductive procedure that has its effect by providing a schedule of reinforcement that is leaner (i.e., reinforcement rate is lower) than what was operating in the pretreatment environment. The behavior targeted for reduction results in reinforcement following a specified time period that includes the absence of the behavior. The length of that time period is systematically increased to achieve lower rates of the target response. DRL is also referred to as differential reinforcement of diminishing rates, or DRD. One difference with this procedure relative to other DR procedures is that it is not intended to eliminate the target response. Rather, it is intended to reduce the frequency with which the response is exhibited.

Relatively few studies utilizing DRL have been published in recent years, given the narrow scope of its utility. DRL-based interventions are often used to reduce excessive response rates related to behavior whose elimination is not desirable, but for which excessive rates can be problematic (e.g., rapid eating). However, Bonner and Borrero (2018) evaluated the utility of DRL-based intervention to reduce and/or eliminate clinically significant SIB. Specifically, Bonner and Borrero implemented a particular type of DRL (full session DRL [*f*-DRL]) in which the reinforcer is delivered if the number of responses during a clinical session (i.e., period of time) is less than or equal to a certain limit. This approach to DRL was conducted as an intervention with four individuals, including two autistics/individuals diagnosed with ASD. Results of the study demonstrated that for these four individuals, the *f*-DRL procedure resulted in reductions in SIB. Specifically, SIB reduced 93% when compared to baseline levels, with participants often exhibiting no self-injurious responses during the clinical sessions.

Differential Reinforcement of Other Behavior Differential reinforcement of other behavior (DRO) can be distinguished from other DR-based procedures in that it does not specify a response following which reinforcers should be delivered. Instead, DRO entails providing the programmed reinforcer following intervals during which no occurrences of the target response were exhibited. DRO programs can incorporate either positive reinforcers (e.g., attention, points, and/or preferred activities) or negative reinforcers (e.g., breaks from non-preferred activities). In typical application, the reinforcer provided is determined by the function of the target problem behavior or is one that has been demonstrated as more valuable than the reinforcer(s) maintaining the target problem behavior. Differential reinforcement of the omission of behavior and differential reinforcement of zero rates of behavior are other terms used interchangeably with DRO.

Nuernberger et al. (2013) implemented a DRO-based intervention to address eyelash, eyebrow, and hair pulling exhibited by an autistic/young woman diagnosed with ASD who had requested assistance with reducing these behaviors. Similar to previous research and clinical demonstrations, the DRO-based intervention resulted in reductions in the target behavior. In addition, the clinicians worked with the individual to develop a self-monitoring program that allowed the intervention to be successfully utilized across the individual's day and activities. Thus, Nuernberger et al. demonstrated that DRO-based interventions could be implemented across longer time periods and could be transferred to the individual for implementation in the natural environment.

Thinning Differential Reinforcement Schedules DR programs are not without their limitations. One such limitation is that the individual can access reinforcers on a frequent basis, resulting in labor-intensive programs when reinforcement delivery requires the presence of a caregiver. In addition, if the individual spends much of the time acquiring and consuming reinforcers, other goals and activities might suffer. For example, if an individual is taught as part of a DRA/FCT program that every request for break results in a cessation of academic instruction, they could conceivably entirely escape/avoid their school work, thus hindering academic progress. To alleviate this concern, many DR programs will focus on reducing the availability of the reinforcer by increasing the response requirement needed to obtain the reinforcer, implementing a delay to reinforcement, or alternating time periods during which reinforcement is available or unavailable (i.e., implement a multiple schedule).

Roane et al. (2004) described a schedule-thinning procedure for two autistic children/children diagnosed with ASD who were evaluated for aggressive behavior. Results of a functional analysis indicated that the children's aggressive behavior was maintained by positive reinforcement. For both participants, treatment consisted of access to 20 s of positive reinforcement contingent on appropriate responding. A substantial decrease in aggression was observed for both children in treatment relative to baseline. At the onset of treatment, the participants had continuous access to response cards that gained them access to positive reinforcement. To increase the treatment's feasibility for caregivers, a reinforcement-thinning procedure was evaluated in which access to the response cards was restricted for a fixed amount of time. For both of the children, low levels of aggressive behavior were maintained when schedule thinning in the form of card restriction was implemented. The authors noted that, by limiting access to alternative responding, caregivers may be able to reduce their direct involvement in treatment.

Hagopian et al. (2005) evaluated the effects of schedule thinning following the implementation of FCT for three autistic children/children diagnosed with ASD who displayed aggressive, self-injurious, and disruptive behaviors. Treatment consisted of functional communication training targeting the functional analysis condition in which the highest rate of problem behavior was observed. A reduction in the target problem behavior occurred for all participants. A schedule-thinning procedure was then implemented. Schedule thinning consisted of instructing the children that they needed to wait after manding for delivery of the reinforcer (either access to attention or to preferred tangible items). The length of the delay between manding and reinforcer delivery was progressively increased until a terminal schedule goal was obtained (4 min). The criterion for increasing the delay was two consecutive sessions with a rate of problem behavior at or below 0.2 responses per min. If problem behavior occurred at a rate of greater than 0.2 responses per min across two consecutive sessions, the delay was reduced to the previous response schedule where the terminal goal had been achieved. For all three participants, the treatment goal of at least 4 min was achieved.

More recently, schedule-thinning approaches have focused on alternating availability of reinforcement, signaled by some stimulus in the environment. This approach, known as multiple schedule thinning, includes sessions comprising two components, each indicated by a unique stimulus. One stimulus signals the availability of reinforcement, and alternative responses exhibited when this stimulus is present result in delivery of the programmed reinforcer. The other stimulus signals the unavailability of reinforcement. Alternative responses exhibited when this stimulus is present do not result in delivery of the programmed reinforcer (i.e., extinction is in place). Schedule thinning using this approach typically involves decreasing the duration of the reinforcement component while increasing the duration of the extinction component (see, Hanley et al., 2001). Greer et al. (2016) reported a summary of 18 FCT interventions that incorporated multiple schedule thinning. Reductions in challenging behavior of 75% or greater, when compared to pre-intervention baseline, were maintained for all 18 individuals as the reinforcement schedule was thinned (i.e., the reinforcement component was decreased in time relative to the extinction component). These results highlighted the utility of this approach making DRA-based interventions such as FCT more practical for implementation in day-to-day environments.

Behavioral Momentum Interventions “Behavioral momentum” refers to the demonstrated phenomenon that a response’s history of reinforcement impacts its resistance to change in the presence of stimuli associated with reinforcer delivery (the reader is directed to Nevin et al., 1990; Nevin et al., 1983, for more information on this topic). Examples of reinforcement-history-related variables that have been demonstrated to impact response persistence include reinforcement rate and magnitude (Nevin, 1974; Nevin et al., 1990). In application, the relation between reinforcement history and response persistence has been utilized to increase the likelihood an individual will complete an instruction with a previously demonstrated low probability of completion. This process typically involves presenting a series of instructions with a previously demonstrated high probability of completion, followed by a reinforcer of some type contingent on completion, prior to delivering the low-probability instruction. Given the locally dense reinforcement history for competing instructions, the likelihood of completing the low-probability instruction increases. While some characterize behavioral momentum-based interventions as an antecedent approach, it is discussed in this section because its utility relies on the reinforcement provided for compliance with the high-probability request and not simply the presentation of those requests (see Zuluaga & Normand, 2008, for a specific evaluation of this difference).

Cowan et al. (2017) conducted a meta-analysis of published, single-case design research studies that evaluated behavioral momentum-based interventions to increase academic behavior exhibited by students diagnosed with ASD. Results of this meta-analysis noted that the intervention produced an 80% improvement in behavior from baseline to intervention and further suggested that behavioral momentum interventions produced very large effect sizes. However, the authors also noted several limitations with published studies, including lack of procedural fidelity data, lack of social validity measures, and inadequate reporting of the training and qualifications of the implementers who participated in or conducted the research studies.

Extinction

Extinction is not a consequence-based intervention, per se, in that it does not specify an outcome to occur following a response. Rather, extinction refers to "discontinuing reinforcement of responding" (Catania, 1998, p. 389). In application, this type of procedure is used as a behavior-reduction technique, and requires that the reinforcer maintaining responding is known so that it can be withheld. Thus, extinction addresses behavior on the consequence side from the perspective of withholding a relevant stimulus when behavior occurs. The procedure is straightforward as it does not require the delivery of reinforcers or punishers. Thus, alternative behavior does not have to be monitored from a procedural standpoint.

While extinction can be an effective behavior-reduction technique, there are a number of considerations to take into account prior to implementation. First, extinction procedures effectively reduce, if not eliminate, individuals' exposure to reinforcing stimuli. Second, extinction procedures do not teach the individual any appropriate methods for recruiting meaningful reinforcers. And, third, extinction procedures can result in an initial increase in target problem behavior (i.e., an extinction burst occurs) and/or can result in variations in response topography, such as the emergence of aggressive behavior (Lerman et al., 1999).

Consequence: Punishment and Punishment-Based Procedures

Punishment is a phenomenon that occurs naturally that impacts behavior in a continuous way. In fact, the principle of punishment is applied, informally, across a variety of domains and situations throughout society. Examples of common societal applications of punishment include suspension or termination of posting privileges on social media platforms, demotion or termination for job performance, and fines or loss of driving privileges for traffic violations.

The field of ABA, along with ABA-based certification and professional organizations, has provided positions and ethical standards pertaining to punishment-based procedures. The Association for Behavior Analysis International (ABAI) has addressed a variety of issues pertaining to the application of punishment-based procedures (i.e., Van Houten et al., 1988; Vollmer et al., 2011). Van Houten et al. (1988) and Vollmer et al. (2011), in their position statements, emphasized the consideration of certain factors when practitioners contemplate the use of punishment-based procedures. First, clients have a right to effective behavioral treatments (Van Houten et al., 1988; Vollmer et al., 2011). Although punishment-based procedures may not be a desired approach given potential side effects (Baer, 1971; Iwata, 1988), when balanced against severe problem behavior (when alternative, non-punishment-based approaches [e.g., antecedent and/or reinforcement-based procedures] are not possible or effective) and its continued occurrence, punishment-based procedures may be the only approach that is effective in certain situations. Second, Vollmer et al. emphasized that practitioners should consider and utilize treatments that are based on the principle of least restrictiveness. Vollmer et al. (p. 104) asserted that it should not be assumed that non-punishment-based procedures will always have a superior "favorable risk-to-benefit ratio" within the context of the principle of least restrictiveness. Rather, Vollmer et al. asserted that practitioners should determine risk-to-benefit ratios using several variables including (a) the effects of the target behavior (e.g., To what extent does the behavior of concern compete with learning? To what extent is the behavior of concern causing tissue damage to others and self? Is the behavior of concern causing social isolation?), (b) duration of treatment (e.g., FCT plus punishment-based procedure may considerably reduce the duration of intervention versus FCT alone), and (c) the likely success of intervention (e.g., FCT or noncontingent reinforcement [NCR] isolation is not effective without punishment-based components). Third, practitioners should ensure the safety of their clients and prioritize their welfare (Vollmer et al., 2011). In other words, the interests and welfare of the individual "must take precedence over the broader agendas of institutions or organizations that would prohibit certain procedures regardless of individual's needs" (Vollmer et al., 2011, p. 104). Last, practitioners should only utilize punishment-based procedures (a) after antecedent, reinforcement, or a combined antecedent and reinforcement-based approach is tried and demonstrated to be ineffective or determined to be unavailable given the conditions of the clinical case, and (b) when they are combined with non-punishment-based procedures (Vollmer et al., 2011).

The principles described above were illustrated by Falcomata et al. (2007). Specifically, the authors implemented punishment-based procedures after non-punishment (i.e., reinforcement) procedures were shown to be ineffective at reducing dangerous pica behavior exhibited by a 12-year-old autistic boy/boy diagnosed with ASD. The authors first implemented noncontingent reinforcement (NCR) in the form of enriched environment (EE) to treat severe pica maintained by automatic reinforcement. Because NCR/EE was ineffective, the authors added a time-out procedure to the NCR/EE arrangement along with a stimulus control-based component. The time-out procedure, in combination with NCR/EE and the stimulus control component, effectively decreased pica to socially relevant levels (i.e., near-zero rates). Overall, the severity of pica exhibited by the individual in Falcomata et al. (e.g., open safety pins lodged in his throat, see Falcomata et al., 2007) clearly justified the use of punishment (e.g., evidence based, favorable in terms of the risk-to-benefit ratio, the welfare of the client was clearly prioritized given these factors, effective).

Antecedent Approaches to Treatment

ABA programs have traditionally focused on the response–reinforcement relationship. However, as programs have evolved over the years, focus has shifted from consequence-based approaches to approaches that focus on manipulating the antecedents relevant to target behavior. ABA-based, antecedent-based intervention (ABI) approaches to treatment have been identified as evidence-based practices (Steinbrenner et al., 2020). In the following paragraphs, several ABA-based ABI procedures will be reviewed including (a) manipulations of establishing operations (EOs), (b) stimulus control, (c) choice, (d) prompt strategies, and (e) noncontingent reinforcement (NCR) or time-based schedules of reinforcement.

Establishing Operations

EOs are those events that alter the reinforcing efficacy, or value, of the reinforcers maintaining a response (Michael, 1982). EOs can be further differentiated by their specific effect on the value of the reinforcer. *Motivating operations (MOs)* are operations that increase the value of the reinforcer. The most basic example of this operation includes deprivation. *Abolishing operations (AOs)* are operations that decrease the value of the reinforcer. The most basic example of this operation includes satiation (Laraway et al., 2003). MOs result in increased response rates maintained by the reinforcer, whereas AOs result in decreased response rates maintained by the reinforcer. Manipulations of EOs have been applied to the treatment of behavior problems exhibited by individuals with autism and other disabilities. Two approaches have been taken in this respect including (1) providing the reinforcer on a fixed-time, or noncontingent basis (e.g., Reed et al., 2005) and (2) presession exposure to a reinforcer.

Cengher and Fienup (2020) manipulated EOs by providing presession access to attention and evaluated its subsequent effects on acquisition of verbal skills by autistic children/children diagnosed with ASD. The study was conducted in each participant's respective classroom. The authors conducted two experiments in which they focused on tacts (Experiment 1) and intraverbals (Experiment 2). During both experiments, the authors compared conditions that consisted of (a) presession access to attention (PA) and (b) no presession access (NPA). In addition, the authors included a control condition with which they compared the two test conditions (i.e., PA and NPA). All participants in both experiments acquired the verbal skills in the NPA condition while four of six participants acquired the verbal skills in the PA condition. Further, fewer training sessions were required to meet mastery criterion when no presession access to attention was provided relative to the PA condition with five of six participants. Overall, Cengher and Fienup showed that manipulating EOs in the form of presession access to reinforcement positively impacts acquisition of verbal skills by autistics/individuals diagnosed with ASD.

DeRosa et al. (2015) evaluated the effects of EO manipulations on problem behavior and appropriate communication exhibited by autistics/individuals diagnosed with ASD during FCT. Specifically, the authors manipulated the duration of exposure to relevant EOs with two autistic individuals with ASD diagnoses. The study, which was conducted in a therapy room in a clinical setting, consisted of two experimental arrangements (i.e., Study 1 and Study 2). Prior to the study, the authors conducted functional analyses of problem behavior and found that it was maintained by escape from non-preferred activities with one participant and attention with the second participant. During Study 1, the authors implemented FCT across two conditions including (1) one in which the target mand for communication was touching a picture card and (2) one in which the target mand was a vocal response. During both conditions, the authors implemented a progressive prompt delay procedure (i.e., no prompt; vocal prompt; model prompt; physical guidance [with the card mand only]). During the picture card condition, the participant always contacted reinforcement (i.e., the EO was removed) because the physical guidance prompt could be provided if no responding occurred after the model prompt. Conversely, the physical guidance prompt could not be implemented with the vocal prompt. Consequently, unless the participant exhibited the vocal mand independently or following the vocal or model prompt, the EO remained in place (i.e., reinforcement was not provided). The results of Study 1 showed (a) both participants exhibited considerably less problem behavior and quicker mand acquisition rates during the card-touch condition and (b) both participants exhibited no extinction bursts in the card-touch condition while they did engage in extinction bursts in the vocal mand condition. During Study 2, the authors sought to confirm the hypothesis that the results of Study 1 were due to durations of exposure to the EOs by implementing time-based schedules of reinforcement that were yoked to the schedules of obtained reinforcement in Study 1. The results showed that problem behavior was considerably higher during the time-based schedule condition associated with the vocal mand relative to the time-based schedule condition associated with the card-touch mand. Thus, smaller exposures to the EO were associated with fewer instances of problem behavior. Overall, the results of DeRosa and Fisher suggested that exposure to relevant EOs associated with problem behavior during FCT can impact the effectiveness of the treatment.

Stimulus Control

Stimulus control is an outcome that emerges after repeated pairings between specific stimuli and consistent consequences. According to Sulzer-Azaroff and Mayer (1991), stimulus control is demonstrated when a particular behavior is predictably occasioned by specific antecedent stimuli. Stimulus control can be systematically achieved by only reinforcing specific responses in the presence of a unique stimulus. Or, stimulus control can emerge naturally as individuals' behavior is exposed to different contexts and their respective reinforcement schedules. For example, a child might learn that requesting bathroom breaks is always reinforced (i.e., the child is allowed to leave the classroom) when Teacher A is asked. However, Teacher B never allows the child to leave following such requests. In this scenario, requests will maintain in the presence of Teacher A and eventually decrease in the presence of Teacher B. Stimulus control can also emerge when punishment is the consistent consequence. For example, if one care provider always responds to a problem with an aversive consequence (e.g., timeout), but another care provider does not provide any consistent consequence, problem behavior would likely decrease in the presence of the first parent only, because that parent's presence and punishment have been paired.

Stimulus control procedures can be used effectively to teach beneficial skills to autistics/individuals diagnosed with ASD. For example, Kaplan-Reimer et al. (2011) used a stimulus control procedure to teach three autistics/individuals diagnosed with ASD to engage in indoor rock climbing. The authors developed three climbing routes with each route having a designated colored tape associated with it. Concurrently, the individuals wore colored bracelets that corresponded with the designated routes during individual trials. Correct route engagement was reinforced via a conditioned reinforcer (an auditory stimulus that was previously established as a conditioned reinforcer via pairings with preferred edible reinforcers). The authors also corrected the individuals when they reached for and grabbed in an "incorrect" hold (i.e., one that had a piece of tape not targeted for that particular climb). Over time, as the individuals demonstrated success, a stimulus fading procedure was implemented in which pieces of tape were slowly and systematically removed. Last, the authors conducted generalization and follow-up probes to evaluate the extent to which the skills generalized (to other parts of the gym) and maintained. Individuals acquired the climbing skills and generalized them to other settings; and the skill maintained over time.

At times, autistics/individuals diagnosed with ASD will engage in high rates of repetitive behaviors (i.e., stereotypy) of various forms (e.g., vocal; motor). Stereotypy, although not considered problematic in and of itself, can effectively compete with social, vocational, and/or educational programming and the acquisition of skills. Thus, treatments have been developed with the aim of teaching autistics/individuals diagnosed with ASD to minimize stereotypy in learning situations while still being able to engage in the behavior during times in which the behavior is not problematic for the individual. Inhibitory stimulus control procedures can be of value. For example, Tiger et al. (2017) implemented a procedure in which the individual was taught "time and place" in terms of engagement in a particular repetitive behavior ("car hoarding" in which the individual collected and carried toy cars in his pockets). This behavior was problematic during particular times (e.g., outside the home in which he would take others' cars, appear to shoplift), which warranted intervention. The authors first conducted a functional analysis and showed that repetitive behavior was maintained by automatic reinforcement. The authors blocked the behavior during targeted times and in the presence of an S- (a green toy car). Also, as part of the stimulus control training procedure, the authors did not block the behavior when the S- was absent. The individual learned to avoid engagement in the behavior in the presence of the S- while continuing to engage in the behavior when the S- was absent. In this way, Tiger et al. were able to avoid suppression of the behavior across all situations and settings. Such an outcome would not be ideal both for ethical and practical reasons. Instead, the authors implemented a procedure that allowed for the occurrence of the behavior during acceptable times (e.g., not ostracizing or disruptive; Tiger et al., 2017).

Choice

Providing a choice within behavioral treatment programs has been demonstrated to be an effective strategy for reducing problem behavior (e.g., Dibley & Lim, 1999; Rispoli et al., 2013). Within the context of behavioral treatment, choice can be considered an antecedent variable because it is in operation before the target response occurs and not in response to a behavior. Rispoli et al. (2013) evaluated the relative effects of across-activity choices and within-activity choices on escape-maintained problem behavior exhibited by four autistics/individuals diagnosed with ASD. In the across-activity condition, the authors provided the individuals with an array of activity options (e.g., handwriting tasks, math worksheets, reading, writing) and prompted them to select an activity. After the participants made their selection, the authors implemented task demands. The authors responded to all occurrences of problem behavior with vocal redirections back to work and planned ignoring (i.e., extinction). The within-activity condition was identical to the across-activity condition except that the authors chose the activity and subsequently provided a choice between different aspects of the chosen activity (e.g., location, materials, how to respond to answers [e.g., Yoda® or Darth Vader® voices]). The results showed that both choice arrangements were effective at decreasing problem behavior relative to baseline. The results also showed that the across-activity arrangement produced less problem behavior than the within-activity choice arrangement for three of the four participants. Overall, the study results showed that (a) providing choices positively impacted the occurrence of problem behavior and (b) parametric aspects of the choice arrangements can further impact the occurrence of problem behavior. In the case of escape-maintained problem behavior (e.g., Rispoli et al., 2013), it is possible that providing choices may decrease the motivation to escape aversive activities.

Prompt Procedures

Prompts have been defined by Cooper et al. (2019) as antecedent stimuli that occasion specific responses and are supplemental to a behavioral treatment. There are at least two broad categories of prompts: response prompts and physical prompts. Response prompts such as physical guidance target behavior. Stimulus prompts target the conditions that exist prior to the occurrence of a target behavior. Stimulus prompts are often used as a means to occasion behavior. When responding is more frequent and reliable in the presence of naturally occurring stimuli, these auxiliary stimuli can be removed.

Cengher et al. (2016) evaluated the relative effects of two distinct prompting strategies that varied in terms of how they were faded. Specifically, the authors first assessed distinct prompt topographies (i.e., no prompt/vocal discriminative stimulus, model, gestural, partial physical, full physical) by investigating the extent to which they produced correct responses across ten one-step directives (e.g., clap, jump, point, sit down) with three autistics/individuals diagnosed with ASD. Next, the authors compared least-to-most (LTM) to most-to-least (MTL) prompt fading while also only including prompt topographies that had been identified as effective via the initial prompt assessment at producing correct responding. In the LTM condition, the authors first provided a verbal discriminative stimulus followed by the least assistance-intensive prompts in sequence. In the MTL condition, the authors initially provided the most assistance-intensive prompt (i.e., full physical) followed by lesser assistance-intensive prompts in sequence. In both conditions, after two consecutive trials in which the participants exhibited correct responding on a given prompt, the authors implemented a less assistance-intensive prompt. With all three individuals, both prompting procedures were effective relative to a control condition in which neither was used. The results also showed that the MTL prompting arrangement was more effective than the LTM arrangement at producing correct responding.

Combining Antecedent and Consequence-Based Components

In practice, the treatments described so far throughout this chapter are often combined to form larger treatment packages. Antecedent and consequence-based interventions are often combined as part of a comprehensive treatment program. For example, the referenced Reed et al. (2005) study included a differential reinforcement component (i.e., breaks contingent on compliance) and a noncontingent reinforcement component (i.e., fixed-time delivery of breaks). The noncontingent reinforcement component can be conceptualized as an antecedent approach that would affect the MO for escape-related behavior. Thus, motivation to engage in problem behavior, previously demonstrated to be maintained by escape, should have been reduced because the participants had access to this reinforcer on a fixed-time basis.

ABA-Based Comprehensive Approaches to Autism Treatment

Intervention Programs That Utilize Applied Behavior Analysis Procedures

Over the past half century, several wide-ranging interventions and treatment programs have been developed to address the difficulties in social interactions, communication, play, and interfering behaviors that are commonly experienced by autistic individuals diagnosed with ASD. Based on research conducted during this timeframe, ABA is considered an evidence-based practice and is viewed as the most effective approach for addressing core challenges experienced by autistic individuals diagnosed with ASD (Smith, 2012; Leaf et al., 2021). In this section, a brief overview of three widely utilized approaches that utilize ABA procedures will be provided. These treatment approaches, whose development spans several decades, were selected to provide readers with an understanding of the evolution of how ABA techniques have been utilized in childhood intervention programs. References will be provided for each of these programs so that the reader can obtain additional information if desired.

University of California, Los Angeles (UCLA) Young Autism Project (YAP)

The UCLA YAP Project is an intensive home-based intervention program for young autistics/individuals diagnosed with ASD developed by Ivaar Lovaas and colleagues (http://www.lovaas.com/). This intervention is sometimes referred to as discrete trial teaching (DTT). In the original YAP study, children in the intensive-treatment group received, on average, 40 h of intervention weekly for at least 2 years (Lovaas, 1987). The focus of therapy was on increasing language, attending, imitation, social behavior, play, and self-care skills, and decreasing disruptive behaviors. Intensive teaching was provided through a discrete trial format. Please reference Lovaas (1981) and Maurice et al. (1996) for specific information on discrete trial teaching procedures and curriculum. Children in the minimal-treatment group received similar services but for only 10 h a week, and a third control group of children received an eclectic mix of interventions. Compared to their baseline performance, children in the intensive-treatment group gained an average of 37 IQ points over the course of the treatment, representing an average difference of 31 points higher in comparison to the control group. In addition, 47% of the children in the intensive group successfully completed first grade in a regular education setting. A follow-up study was conducted with those children who successfully completed first grade without support. At the age of 13 years, eight of these nine students were continuing to succeed in regular education settings without support. This group continued to perform significantly higher than the control group on measures of intelligence and adaptive abilities (McEachin et al., 1993).

Based upon the results of these studies and others, the UCLA YAP model has been described as one of the most empirically validated interventions (Simpson, 2005). Many autistic children diagnosed with ASD who participated in YAP demonstrated meaningful growth in the areas of language, social behavior, and academics (Leaf et al., 2021). Subsequent to the seminal article by Lovaas (1987), the methodology based on the YAP program has been widely utilized in home and school settings. See Reichow and Wolery (2009) for a listing of articles that have utilized this methodology and Leaf and McEachin (2016) for history of YAP.

Of note, both methodological and ethical concerns have been raised about the procedures that were employed by Lovaas and colleagues in the YAP program (Gresham & MacMillan, 1998). In an analysis of early intensive behavioral intervention programs based on the YAP methodology, Reichow and Wolery noted that the YAP model has produced strong effects for many children. However, not all children responded positively to this intervention, suggesting that additional research is needed to identify modifications in procedures or alternative intervention procedures that would benefit this subgroup. Ethically, multiple concerns have been raised about YAP including the use of aversives including shock, the intensity of the treatment, the lack of individualized treatment, and the treatment's intended outcome of "curing" ASD. These are important concerns that require appropriate evaluation and discussion. A thorough discussion of common concerns that have been raised about the work of Lovaas and YAP is beyond the scope of this chapter. The authors encourage interested readers to read the article by Leaf et al. (2021) for additional context and discussion.

Treatment and Education of Autistic and Related Communication-Handicapped Children (TEACCH)

The TEACCH Autism Program is a visually based approach that contains several components focused on modifying the environment to meet the individualized needs of autistics/individuals diagnosed with ASD (http://www.teacch.com/). This comprehension intervention approach is often referred to as structured teaching (Simpson, 2005). TEACCH was developed by Eric Schopler and colleagues at the University of North Carolina in the early 1970s. The overriding goals of TEACCH are to teach children as many independent skills and routines as possible and to individually modify the environment to make it more meaningful for autistic children/children diagnosed with ASD (Turner-Brown & Hume, 2020). Caregivers are viewed as co-therapists and are actively engaged in learning TEACCH techniques.

Over the past several decades, TEACCH programming has been used in classrooms, homes, and in community settings across the world. The four main components of the TEACCH program are (1) physical organization and structure, (2) daily schedules, (3) work systems, and (4) task structure. Examples of these four visually based components that are commonly used include: establishing clear visual and physical boundaries in rooms to minimize visual and auditory distractions, developing physically separate work and leisure areas in classrooms, the use of schedules (e.g., object, picture, icon, or written word schedules) to increase independence, individualized work systems to increase an individual's understanding of what and how much work needs to be done, and incorporating visual structure within tasks. Visual Activity Schedules, a category of visual supports that originated from TEACCH, are considered an evidence-based practice. A recent review found that visual activity schedules have been effectively utilized to increase on-task behaviors, to increase independence with transitions, to decrease the latency to task initiation, and to decrease the level of prompts that are needed for transitions (Knight et al., 2015). Please see Mesibov and Howley (2003), Mesibov et al. (2004), and Turner-Brown and Hume (2020) for details on TEACCH procedures.

Through the use of visual and external organization procedures, TEACCH attempts to increase an individual's understanding of situations and expectations by helping them to answer the following questions: (1) Where am I supposed to be? (2) What am I supposed to do? (3) How long should I do it? (4) How long will I do this/how many should I do? (5) How will I know when I am done? (6) What will happen next? By providing supports to answer these questions TEACCH aims to decrease anxiety and frustration experienced by some persons with ASD related to comprehension and communication difficulties. Because of TEACCH's focus on environmental manipulations, the program can be viewed as containing a series of antecedent-based strategies.

Naturalistic Developmental Behavioral Interventions

Several empirically validated treatments have been developed for young autistic children/children diagnosed with ASD over the past several years, which integrate ABA with techniques drawn from developmental sciences. These treatments represent a shift in focus from a reliance on the DTT methodologies popularized by Lovaas (1987) to the incorporation of various ABA techniques in natural settings with natural contingencies. Referred to as Naturalistic Developmental Behavioral Interventions (NDBIs), this group of treatments shares several common features including: antecedent-response-consequence contingencies embedded throughout treatment, use of prompts and prompt fading, modeling, manualized practice, fidelity of implementation criteria, individualized treatment goals, ongoing measurement of progress, child-initiated teaching episodes, arranging the natural environment to motivate the child to communicate and engage, use of natural reinforcement to increase motivation, and adult imitation of the child's play, communication, and body movements (Schreibman et al., 2015; Frost et al., 2020). NDBIs are considered to be a best practice in the treatment of young children based on their integration of these developmental and behavioral approaches (Zwaigenbaum et al., 2015). Examples of empirically validated NDBIs include Early Start Denver Model (ESDM; Rogers et al., 2012), Improving Parents as Communication Teachers (ImPACT; Ingersoll & Wainer, 2013), and Pivotal Response Training (PRT; Koegel & Koegel, 2006).

ABA Across the Lifespan

With the strong public health focus on early identification of and intervention for autistics/individuals diagnosed with ASD, the majority of the focus has been on the pediatric population. Despite the fact that most people spend the majority of their lives as adults, it has been estimated that as little as 2% of funding for autism research targets the adult population (https://iacc.hhs.gov/publications/portfolio-analysis/2016). Fortunately there has been increasing awareness about the critical importance of programs to support the individualized needs of autistic adults/adults diagnosed with ASD (Roux et al., 2021). Though more limited in comparison to the emphasis on children, a body of research exists to support the efficacy of ABA in addressing some of the core challenges experienced by many autistic adults. ABA techniques have been studied and applied to address needs in the areas of social engagement, vocational and work skills, and promoting leisure activities. The following is a very brief summary to provide readers with examples of ABA applications with autistic adults.

As a group, autistic adults/adults diagnosed with ASD are employed at much lower rates than adults without ASD (Sump et al., 2019). This statistic is of concern because employment is associated with a number of positive benefits, including positive health outcomes and overall social well-being (Roux et al., 2013). Multiple factors contribute to lower rates of employment for autistic adults/adults diagnosed with ASD, including the high prevalence of intellectual disability, medical and psychiatric comorbidities in the ASD population, limited opportunities for autistic adults/adults diagnosed with ASD to receive adequate job training and job coaching, and a lack of adequate job accommodations and supports in many settings.

In a systematic review of studies focused on promoting employment skills for autistic adults/adults diagnosed with ASD, Anderson et al. (2017) determined that one approach based on ABA principles, Behavioral Skills Training (BST), is considered to be evidence based. BST is a set of behavioral procedures that are used in combination to teach new skills. Most BST programs utilize direction instruction, modeling, prompting strategies, rehearsal, corrective feedback, and reinforcement. For instance, Lerman et al. (2015) used a multiple baseline design across participants to evaluate the outcomes of a BST intervention teaching autistic adults/adults diagnosed with ASD without intellectual disability skills needed to serve as behavior technicians for young autistic children/children diagnosed with ASD. BST was effective in teaching the participants several behavior technician skills with a high level of procedural integrity. In a second experiment, the authors demonstrated that the adult participant's skills generalized to other technician target behaviors and to other children not included in the training. Ratings provided by Board Certified Behavior Analysts (BCBAs) who worked with behavior technicians indicated that some of the participants' skills were indistinguishable from those of typically developing adults in similar behavior technician roles. Other applications of BST include teaching an autistic adult/adults diagnosed with ASD computer skills (Sump et al., 2019) and skills needed for working at a recycling business (Dotson et al., 2013). While studies indicate that BST is an effective approach for teaching autistic adults/adults diagnosed with ASD a variety of vocational skills, additional research on employment-specific applications of ABA is an area of ongoing need.

Some research has suggested that many autistic adults/adults diagnosed with ASD struggle to find and maintain employment due, at least in part, to difficulties with navigating the complex social interactions that can occur in work environments. For instance, Lerman et al. (2017) noted that effective work performance required the use of a variety of social behaviors such as responding appropriately to feedback and asking for help when needed. The authors conducted a study in which, within a contrived clinic setting, they simulated a variety of social skills that may be required at work. Participants were eight adolescents and young autistic adults/adults diagnosed with ASD. The participants were evaluated in their use of a variety of work-related skills including notifying a supervisor if a work task was completed, asking for help with a task or if materials were missing, on-task behavior and work completion, and responding to corrective feedback. The participants' responses were observed across these variables with a "supervisor" (experimenter) when they were given either clear instructions, vague instructions, multiple-step instructions, missing materials, or tasks outside of their repertoire. Results indicated that work-based social skills can be evaluated in a clinical environment. The authors note that a next important step is to determine if a similar evaluation of social behaviors can be effectively conducted in a more naturalistic employment environment.

Future Directions and Summary

A number of areas are ripe for future research and application involving the use of ABA methodology to address challenges experienced by autistics/individuals diagnosed with ASD. Within the area of early identification, recent research has suggested that autism can be reliably identified in many children as young as 12–18 months of age. Given the demonstrable positive effects of early intervention, it will be important to determine if ABA procedures can be tailored to working with toddlers recently diagnosed or strongly suspected of having an autism spectrum disorder.

Individualizing treatment based upon our knowledge of autism is another area of future focus. As more has been learned about the heterogeneous presentation of autism spectrum disorders, clinicians can increasingly focus on isolating key components that are most likely to lead to successful outcomes for different subgroups. It might be the case, for example, that different cognitive and communicative patterns may preclude or predispose individuals on the spectrum to treatment strategies that rely more heavily on antecedent-based interventions. Research can also increasingly focus on issues related to clinical outcomes. For instance, with respect to generalization and maintenance of skills, what represents the best mode of delivery for treatment: discrete trial training or training in naturally occurring situations?

Finally, outside of the clinical and research realm, the rapid increase in the number of individuals diagnosed with autism will likely mean that the policies put in place to assist such individuals will require close review. At the time that this chapter was revised in 2022, all 50 states currently cover ABA treatments for autistic children/children diagnosed with ASD who are enrolled in Medicaid. In addition, all states have mandates as of 2019 that require private insurance companies to cover autism treatments. The specific coverage requirements vary by health plan (see https://www.autismspeaks.org/health-insurance-coverage-autism for information regarding different types of coverage). The recent expansion in coverage provides an opportunity to more systematically examine the outcomes of ABA on meaningful developmental variables. For instance, researchers may evaluate differences in specific outcomes such as changes in joint attention or symbolic play among large groups of children with ASD who receive ABA versus another treatment. Similarly, studies may be completed regarding the longer-term impact of ABA treatment on academic, social, and vocational outcomes.

In the preceding pages, we have attempted to provide an overview of ABA concepts as well as studies that illustrate how these concepts have been used to address the social, communicative, and behavioral concerns exhibited by many autistics/individuals diagnosed with ASD. While each of these concepts can be investigated in more depth (and, the reader is invited to do so), what should be apparent is the long-standing empirical nature of evaluation and treatments based upon ABA methodology. It is important to note that, although it did not emerge as an approach specific to autism, ABA has yielded substantial contributions specific to this population.

References

Anderson, A., Moore, D. W., Rausa, V. C., Finkelstein, S., Pearl, S., & Stevenson, M. (2017). A systematic review of interventions for adults with autism spectrum disorder to promote employment. *Review Journal of Autism and Developmental Disorders, 4*, 26–38. https://doi.org/10.1007/s40489-016-0094-9

Andzik, N., Smith, E., & Neef, N. (2022). Using a token economy to treat escape-maintained problem behavior without extinction. *Behavior Modification, 46*(1), 128–146. https://doi.org/10.1177/0145445520966762

Athens, E. S., & Vollmer, T. R. (2010). An investigation of differential reinforcement of alternative behavior without extinction. *Journal of Applied Behavior Analysis, 43*(4), 569–589. https://doi.org/10.1901/jaba.2010.43-569

Baer, D. M. (1971). Lets take another look at punishment. *Psychology Today, 5*(5), 32.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91–97. https://doi.org/10.1901/jaba.1968.1-91

Bonner, A. C., & Borrero, J. C. (2018). Differential reinforcement of low rate schedules reduce severe problem behavior. *Behavior Modification, 42*(5), 747–764. https://doi.org/10.1177/0145445517731723

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126. https://doi.org/10.1901/jaba.1985.18-111

Catania, A. C. (1998). *Learning* (4th ed.). Prentice Hall.

Cengher, M., & Fienup, D. M. (2020). Presession attention affects the acquisition of tacts and intraverbals. *Journal of Applied Behavior Analysis, 53*(3), 1742–1767. https://doi.org/10.1002/jaba.657

Cengher, M., Shamoun, K., Moss, P., Roll, D., Feliciano, G., & Fienup, D. M. (2016). A comparison of the effects of two prompt-fading strategies on skill acquisition in children with autism spectrum disorders. *Behavior Analysis in Practice, 9*(2), 115–125. https://doi.org/10.1007/s40617-015-0096-6

Charlop, M. H., Kurtz, P. F., & Casey, F. G. (1990). Using aberrant behaviors as reinforcers for autistic children. *Journal of Applied Behavior Analysis, 23*, 163–181. https://doi.org/10.1901/jaba.1990.23-163

Cihon, J. H., Ferguson, J. L., Milne, C. M., Leaf, J. B., McEachin, J., & Leaf, R. (2019). A preliminary evaluation of a token system with a flexible earning requirement. *Behavior Analysis in Practice, 12*(3), 548–556. https://doi.org/10.1007/s40617-018-00316-3

Cooper, J. O., Heron, T. E., & Heward, W. L. (2019). *Applied behavior analysis* (3rd ed.). Pearson Education.

Cowan, R. J., Abel, L., & Candel, L. (2017). A meta-analysis of single-subject research on behavioral momentum to enhance success in students with autism. *Journal of Autism and Developmental Disorders, 47*, 1464–1477. https://doi.org/10.1007/s10803-017-3076-6

Derosa, N. M., Fisher, W. W., & Steege, M. W. (2015). An evaluation of time in establishing operation on the effectiveness of functional communication training. *Journal of Applied Behavior Analysis, 48*(1), 115–130. https://doi.org/10.1002/jaba.180

Dibley, S., & Lim, L. (1999). Providing choice making opportunities within and between daily school activities. *Journal of Behavioral Education, 9*, 117–132. https://doi.org/10.1023/A:1022888917128

Dotson, W. H., Richman, D. M., Abby, L., Thompson, S., & Plotner, A. (2013). Teaching skills related to self-employment to adults with developmental disabilities: An analog analysis. *Research in Developmental Disabilities, 34*, 2336–2350. https://doi.org/10.1016/j.ridd.2013.04.009

Falcomata, T. S., Roane, H. S., & Pabico, R. R. (2007). Unintentional stimulus control during the treatment of pica displayed by a young man with autism. *Research in Autism Spectrum Disorders, 1*(4), 350–359. https://doi.org/10.1016/j.rasd.2006.12.004

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. Appleton-Century-Croft.

Fisher, W. W., Greer, B. D., Fuhrman, A. M., Saini, V., & Simmons, C. A. (2018). Minimizing resurgence of destructive behavior using behavioral momentum theory. *Journal of Applied Behavior Analysis, 51*(4), 831–853. https://doi.org/10.1002/jaba.499

Frost, K. M., Brian, J., Gengoux, G. W., Hardan, A., Rieth, S. R., Stahmer, A., & Ingersoll, B. (2020). Identifying and measuring the common elements of naturalistic developmental behavioral interventions for autism spectrum disorder: Development of the NDBI-Fi. *Autism, 24*(8), 2285–2297. https://doi.org/10.1177/1362361320944011

Greer, B. D., Fisher, W. W., Saini, V., Owen, T. M., & Jones, J. K. (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. *Journal of Applied Behavior Analysis, 49*, 105–121. https://doi.org/10.1002/jaba.265

Gresham, F. M., & MacMillan, D. L. (1998). Early intervention project: Can its claims be substantiated and its effects replicated? *Journal of Autism and Developmental Disorders, 28*, 5–13. https://doi.org/10.1023/A:1026002717402

Grow, L. L., Kelley, M. E., Roane, H. S., & Shillingsburg, A. M. (2008). Utility of extinction-induced response variability for the selection of mands. *Journal of Applied Behavior Analysis, 41*, 15–24. https://doi.org/10.1901/jaba.2008.41-15

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*, 211–235. https://doi.org/10.1901/jaba.1998.31-211

Hagopian, L. P., Contrucci Kuhn, S. A., Long, E. S., & Rush, K. S. (2005). Schedule thinning following communication training: Using competing stimuli to enhance tolerance to decrements in reinforcer density. *Journal of Applied Behavior Analysis, 38*, 177–193. https://doi.org/10.1901/jaba.2005.43-04

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis, 34*(1), 17–38. https://doi.org/10.1901/jaba.2001.34-17

Ingersoll, B., & Wainer, A. (2013). Initial efficacy of project ImPACT: A parent-mediated social communication intervention for young children with ASD. *Journal of Autism and Developmental Disorders, 43*(12), 2943–2952. https://doi.org/10.1007/s10803-013-1840-9

Iwata, B. A. (1988). The development and adoption of controversial default technologies. *The Behavior Analyst, 11*, 149–157. https://doi.org/10.1007/BF03392468

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2*, 3–20, 1982). https://doi.org/10.1901/jaba.1994.27-197

Kaplan-Reimer, H., Sidener, T. M., Reeve, K. F., & Sidener, D. W. (2011). Using stimulus control procedures to teach indoor rock climbing to children with autism. *Behavioral Interventions, 26*(1), 1–22. https://doi.org/10.1002/bin.315

Knight, V., Sartini, E., & Spriggs, A. D. (2015). Evaluating visual activity schedules as evidence-based practice for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 45*, 157–178. https://doi.org/10.1007/s10803-014-2201-z

Koegel, R. L., & Koegel, L. K. (2006). *Pivotal response treatments for autism: Communication, social, & academic development*. Brookes Press.

Kunnavatana, S. S., Bloom, S. E., Samaha, A. L., Slocum, T. A., & Clay, C. J. (2018). Manipulating parameters of reinforcement to reduce problem behavior without extinction. *Journal of Applied Behavior Analysis, 51*, 283–302. https://doi.org/10.1002/jaba.443

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*, 407–414. https://doi.org/10.1901/jaba.2003.36-407

Leaf, R., & McEachin, J. (2016). The Lovaas model: Love it or hate it, but first understand it. In R. Romanczyk & J. McEachin (Eds.), *Comprehensive models of autism spectrum disorder treatment*. Springer. https://doi.org/10.1007/978-3-319-40904-7_2

Leaf, J. B., Cihon, J. H., Ferguson, J. L., Milne, C. M., Leaf, R., & McEachin, J. (2021). Advances in our understanding of behavioral intervention: 1980 to 2020 for individuals diagnosed with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 51*(12), 4395–4410. https://doi.org/10.1007/s10803-020-04481-9

Lerman, D. C., Iwata, B. A., & Wallace, M. D. (1999). Side effects of extinction: Prevalence of bursting and aggression during the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 32*, 1–8. https://doi.org/10.1901/jaba.1999.32-1

Lerman, D. C., Hawkins, L., Hillman, C., Shireman, M., & Nissen, M. A. (2015). Adults with autism spectrum disorder as behavior technicians for young children with autism: Outcomes of a behavioral skills training program. *Journal of Applied Behavior Analysis, 48*, 233–256. https://doi.org/10.1002/jaba.196

Lerman, D. C., White B., Grob C., Laudont C. (2017). A Clinic-Based Assessment for Evaluating Job-Related Social Skills in Adolescents and Adults with Autism *Behavior Analysis in Practice 10*(4), 323–336. https://doi.org/10.1007/s40617-017-0177-9

Lovaas, O. I. (1981). *Teaching developmentally disabled children: The me book*. University Park Press.

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*, 3–9.

Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, A., et al. (2021). Prevalence and characteristics of Autism spectrum disorder among children aged 8 years – Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2018. *Morbidity and Mortality Weekly Report. Surveillance Summaries (Washington, D.C.: 2002), 70*(11), 1–16. https://doi.org/10.15585/mmwr.ss7011a1

Maurice, C., Green, G., & Luce, S. C. (1996). *Behavioral intervention for young children with autism*. Pro-Ed.

McEachin, J. J., Smith, T., & Lovaas, O. I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97*, 359–372.

Mesibov, G., & Howley, M. (2003). *Accessing the curriculum for pupils with autistic spectrum disorders: Using the TEACCH programme to help inclusion*. David Fulton Publishers.

Mesibov, G. B., Shea, V., & Schopler, E. (2004). *The TEACCH approach to autism spectrum disorders*. Springer.

Michael, J. (1982). Distinguishing between discriminative and motivational functions of stimuli. *Journal of the Experimental Analysis of Behavior, 37*(1), 149–155. https://doi.org/10.1901/jeab.1982.37-149

Nevin, J. A. (1974). Response strength in multiple schedules. *Journal of the Experimental Analysis of Behavior, 21*, 389–408. https://doi.org/10.1901/jeab.1974.21-389

Nevin, J. A., Mandell, C., & Atak, J. R. (1983). The analysis of behavioral momentum. *Journal of the Experimental Analysis of Behavior, 39*, 49–59. https://doi.org/10.1901/jeab.1983.39-49

Nevin, J. A., Tota, M. E., Torquato, R. D., & Shull, R. L. (1990). Alternative reinforcement increases resistance to change: Pavlovian or operant contingencies? *Journal of the Experimental Analysis of Behavior, 53*, 359–379. https://doi.org/10.1901/jeab.1990.53-359

Nuernberger, J. E., Vargo, K. K., & Ringdahl, J. E. (2013). An application of differential reinforcement of other behavior and self-monitoring to address repetitive behavior. *Journal of Developmental and Physical Disabilities, 25*(1), 105–117. https://doi.org/10.1007/s10882-012-9309-x

Randall, K. R., Greer, B. D., Smith, S. W., & Kimball, R. T. (2021). Sustaining behavior reduction by transitioning the topography of the functional communication response. *Journal of Applied Behavior Analysis, 54*(3), 1013–1031. https://doi.org/10.1002/jaba.824

Reed, G. K., Ringdahl, J. E., Wacker, D. P., Barretto, A., & Andelman, M. S. (2005). The effects of fixed-time and contingent schedules of negative reinforcement on compliance and aberrant behavior. *Research in Developmental Disabilities, 3*, 281–295. https://doi.org/10.1016/j.ridd.2004.01.004

Reichow, B., & Wolery, M. (2009). Comprehensive synthesis of early intensive behavioral interventions for young children with autism based on the UCLA young autism project model. *Journal of Autism and Developmental Disorders, 39*(1), 23–41. https://doi.org/10.1007/s10803-008-0596-0

Ringdahl, J. E., Berg, W. K., Wacker, D. P., Crook, K., Molony, M. A., Vargo, K. K., et al. (2018). Effects of response preference on resistance to change. *Journal of the Experimental Analysis of Behavior, 109*(1), 265–280. https://doi.org/10.1002/jeab.308

Rispoli, M., Lang, R., Neely, L., Camargo, S., Hutchins, N., Davenport, K., & Goodwyn, F. (2013). A comparison of within-and across-activity choices for reducing challenging behavior in children with autism spectrum disorders. *Journal of Behavioral Education, 22*(1), 66–83. https://doi.org/10.1007/s10864-012-9164-y

Roane, H. S., Fisher, W. W., Sgro, G. M., Falcomata, T. S., & Pabico, R. R. (2004). An alternative method of thinning reinforcer delivery during differential reinforcement. *Journal of Applied Behavior Analysis, 37*, 213–218. https://doi.org/10.1901/jaba.2004.37-213

Rogers, S. J., Estes, A., Lord, C., Vismara, L., Winter, J., Fitzpatrick, A., et al. (2012). Effects of a brief Early Start Denver Model (ESDM)–based parent intervention on toddlers at risk for autism spectrum disorders: A randomized controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry, 51*(10), 1052–1065. https://doi.org/10.1016/j.jaac.2012.08.003

Romani, P. W., Ringdahl, J. E., Wacker, D. P., Lustig, N. H., Vinquist, K. M., Northup, J., et al. (2016). Relations between rate of negative reinforcement and the persistence of task completion. *Journal of Applied Behavior Analysis, 49*(1), 122–137. https://doi.org/10.1002/jaba.252

Roux, A. M., Shattuck, P., Cooper, B., Wagner, M., & Narendorf, S. (2013). Postsecondary employment experiences among young adults with an autism spectrum disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 52*, 931–939. https://doi.org/10.1016/j.jaac.2013.05.019

Roux, A. M., Rast, J. E., Anderson, K. A., Garfield, T., & Shattuck, P. T. (2021). Vocational rehabilitation service utilization and employment outcomes among secondary students on the autism spectrum. *Journal of Autism and Developmental Disorders, 51*(1), 212–226. https://doi.org/10.1007/s10803-020-04533-0

Rusch, F. R., Rose, T., & Greenwood, C. R. (1988). *Introduction to behavior analysis in special education*. Prentice Hall.

Schlichenmeyer, K. J., Dube, W. V., & Vargas-Irwin, M. (2015). Stimulus fading and response elaboration in differential reinforcement for alternative behavior. *Behavioral Interventions, 30*(1), 51–64. https://doi.org/10.1002/bin.1402

Schreibman, L., Dawson, G., Stahmer, A. C., Landa R., Rogers S. J., McGee G. G., et al. (2015). Naturalistic Developmental Behavioral Interventions: Empirically Validated Treatments for Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders 45*(8) 2411–2428. https://doi.org/10.1007/s10803-015-2407-8

Shirley, M. J., Iwata, B. A., Kahng, S., Mazaleski, J. L., & Lerman, D. C. (1997). Does functional communication training compete with ongoing contingencies of reinforcement? An analysis during response acquisition and maintenance. *Journal of Applied Behavior Analysis, 30*, 93–104. https://doi.org/10.1901/jaba.1997.30-93

Simpson, R. L. (2005). *Autism spectrum disorders: Interventions and treatments for children and youth*. Corwin Press.

Skinner, B. F. (1953). *Science and human behavior*. The Free Press.

Sleiman, A. A., Betz, A. M., Rey, C. N., & Blackman, A. L. (2020). Effects of token manipulation on responding within a token economy implemented with children with autism. *Education and Treatment* *of Children, 43*(4), 323–333. https://doi.org/10.1007/s43494-020-00014-2

Smith, T. (2012). Evolution of research on interventions for individuals with autism spectrum disorder: Implications for behavior analysts. *Behavior Analyst, 35*, 101–113. https://doi.org/10.1007/BF03392269

Steinbrenner, J. R., Hume, K., Odom, S. L., Morin, K. L., Nowell, S. W., Tomaszewski, B., et al. (2020). *Evidence-based practices for children, youth, and young adults with autism*. FPG Child Development Institute.

Sulzer-Azaroff, B., & Mayer, G. R. (1991). *Behavior analysis for lasting change*. Harcourt Brace College Publishers.

Sump, L. A., Mottau, B. C., & LeBlanc, L. A. (2019). Evaluating behavioral skills training to teach basic computer skills to a young adult with autism. *Behavior Analysis in Practice, 12*(2), 331–334. https://doi.org/10.1007/s40617-018-00295-5

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*, 16–23. https://doi.org/10.1007/BF03391716

Tiger, J. H., Wierzba, B. C., Fisher, W. W., & Benitez, B. B. (2017). Developing and demonstrating inhibitory stimulus control over repetitive behavior. *Behavioral Interventions, 32*, 160–174. https://doi.org/10.1002/bin.1472

Trump, C. E., Ayres, K. M., Quinland, K. K., & Zabala, K. A. (2020). Differential reinforcement without extinction: A review of the literature. *Behavior Analysis: Research and Practice, 20*(2), 94–107. https://doi.org/10.1037/bar0000169

Turner-Brown, L., & Hume, K. (2020). The TEACCH approach and other visually based approaches for children with autism. In G. Vivanti, K. Bottema-Beutel, & L. Turner-Brown (Eds.), *Clinical guide to early interventions for children with autism* (Best Practices in Child and Adolescent Behavioral Health Care). Springer. https://doi.org/10.1007/978-3-030-41160-2_7

van Haaren, F. (2017). Differential versus differentiated reinforcement. *Behavior Analysis: Research and Practice, 17*(1), 98–100. https://doi.org/10.1037/bar0000062

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis, 21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Vollmer, T. R., Hagopian, L. P., Bailey, J. S., Dorsey, M. F., Hanley, G. P., Lennox, D., et al. (2011). The Association for Behavior Analysis International position statement on restraint and seclusion. *The Behavior Analyst, 34*(1), 103–110. https://doi.org/10.1007/BF03392238

Vollmer, T. R., Peters, K. P., Kronfli, F. R., Lloveras, L. A., & Ibañez, V. F. (2020). On the definition of differential reinforcement of alternative behavior. *Journal of Applied Behavior Analysis, 53*, 1299–1303. https://doi.org/10.1002/jaba.701

Wells, J. C., Sheehey, P., & Pratt, E. (2019). Reducing elopement in a preschooler with autism using differential reinforcement. *Advances in Neurodevelopmental Disorders, 3*(1), 38–44. https://doi.org/10.1007/s41252-018-0085-1

Zuluaga, C. R., & Normand, M. P. (2008). An evaluation of the high-probability instruction sequence with and without programmed reinforcement for compliance with high-probability instructions. *Journal of Applied Behavior Analysis, 41*, 453–457. https://doi.org/10.1901/jaba.2008.41-453

Zwaigenbaum, L., Bauman, M. L., Choueiri, R., Kasari, C., Carter, A., Granpeesheh, D., Mailloux, Z., Smith Roley, S., Wagner, S., Fein, D., Pierce, K., Buie, T., Davis, P. A., Newschaffer, C., Robins, D., Wetherby, A., Stone, W. L., Yirmiya, N., Estes, A., et al. (2015). Early intervention for children with autism spectrum disorder under 3 years of age: Recommendations for practice and research. *Pediatrics, 136*, S60–S81. https://doi.org/10.1542/peds.2014-3667E

Comprehensive Assessment of Autism Spectrum Disorders

4

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Overview

The evaluation process for autism spectrum disorder (ASD) can vary drastically in the way it looks due to the wide variety of assessments and domains that are included in a comprehensive evaluation. This chapter attempts to delineate best practices in the autism spectrum disorder diagnostic evaluation process by reviewing the domains of interest in an evaluation, the common assessment tools used in these domains, common comorbid diagnoses, and other diagnostic considerations. Additionally, each of these components will vary based on the child's general developmental category (i.e., infant/toddler, childhood/preadolescence, and adolescence) to ensure that tests and procedures were created and normed with similarly aged children and/or developmentally appropriate.

Every evaluation should begin with an intake interview designed to gather information about the child's presenting concerns, developmental history, family history, medical history, and service history. The intake typically involves the primary caregivers of the child but may include other significant adults such as grandparents and service providers. The information gathered in this initial meeting will directly impact the assessment battery chosen to assess the various areas of concern and interest. Autism-specific behaviors, cognitive ability, adaptive behaviors, speech/language ability, restricted interests and repetitive behaviors, sensory abnormalities, and other psychological comorbidities are the areas typically assessed in a comprehensive autism evaluation.

A comprehensive evaluation process should result not only in a diagnosis but also in individualized recommendations for support and interventions services that often include applied behavioral analysis services. These recommendations should be included in the completed testing report and disseminated to parents and other relevant parties during a feedback session. Lastly, future directions for the field of autism diagnostics will be discussed in this chapter as well.

Diagnostic Domains

Autism-Specific

The heart of evaluation for autism spectrum disorder, regardless of age, is the use of tools designed to assess autism-related symptoms and behaviors. Per the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V; American Psychological Association [APA], 2013), autism spectrum disorders are a collection of neurodevelopmental disorders characterized by differences in social communication, difficulty with social interaction, and restricted and repetitive behaviors and interests. Individuals with autism can present with a vast array of difficulties with social communication and interaction such as a lack of initiation of social interaction, decreased social-emotional reciprocity, infrequent and/or poorly modulated eye contact, failing to integrate verbal and nonverbal communication, difficulty with creating and maintaining relationships with others, a lack of imaginative play, and little interest in their peers. ASD is also characterized by the presence of restricted and repetitive behaviors and interests (RRBIs). For children and adolescents, this can present as repetitive or ritualistic play, difficulties with transitions, insistence on sameness, intense interests in certain objects or subjects, and sensory abnormalities. Comprehensive evaluation of autism spectrum disorder should contain evaluation instruments that assess these domains. Fortunately, there are a number of instruments that can be used to accomplish this goal across childhood and adolescence. Additionally, these instruments are used to obtain evidence for an autism spectrum disorder diagnosis through multiple formats, including parent/caregiver report, teacher report, structured interview procedures, and clinical observation.

Parent/caregiver and teacher report tools are vital to both screening for ASD and to gain an understanding of an individual's symptoms and behaviors from the perspective of important stakeholders in their lives. Prior to be referred for a comprehensive evaluation for autism spectrum disorder, children are often screened using a measure such as the Modified Checklist for Autism in Toddlers, Revised (M-CHAT-R; Robins et al., 2009). The M-CHAT-R is a brief, parent report screening tool used to assess risk for autism spectrum disorder among toddlers between ages of 16 and 30 months. The M-CHAT-R is a free instrument, often used by primary care and pediatric physicians to provide a quick screener for early signs of autism with minimal training (Sturner et al., 2016). Physicians can use the follow-up interview to further screen children who have been identified as medium-risk, while children that fall in the high-risk range should be bypassed for the follow-up interview and instead be recommended for early intervention services and a diagnostic evaluation. Unfortunately, the M-CHAT-R only covers a small age range. The Gilliam Autism Rating Scale, Third Edition (GARS-3; Gilliam, 2013) is another screening tool with a wider age range of 3–22 years. It is more comprehensive than the M-CHAT-R, with 56 items and six subscales assessing restrictive/repetitive behaviors, social interaction, social communication, emotional responses, cognitive style, and maladaptive speech. The GARS-3, much like any screening tool, should be used with caution as it should not be used in isolation to make a diagnosis. The instrument was revised to reflect the change in diagnostic criteria for ASD in the DSM-V, but may still have low sensitivity for individuals that do not have a comorbid intellectual disability (Nickel & Huang-Storms, 2017). In general, both of these measures should be used as screeners for autism spectrum disorder rather than stand-alone evidence for a diagnostic classification and while these are a few of the most commonly used screeners in our field, there are several other well-validated tools that can be used as part of a comprehensive ASD battery.

A few excellent alternatives to the M-CHAT and GARS include measures such as the Autism Spectrum Rating Scales, the Baby and Infant Screen for Children with aUtIsm Traits, Autism Spectrum Disorders – Child, and the Social Responsiveness Scale-Second Edition. These tools provide a greater breadth of information about the presence and severity of symptoms and can be used both as screeners or as part of a larger comprehensive assessment battery. The Autism Spectrum Rating Scales (ASRS; Goldstein & Naglieri, 2009) are a set of forms created to measure behaviors associated with autism by a child's caregiver or teacher for children between the ages of 2 and 18 years. There are a total of four different forms for the age ranges of 2–5 years and 6–18 years, with options of caregiver or teacher reports for each age range. Additionally, there is a short form for each age range that could be completed by caregivers or teachers; however, this should be used as a screener or for treatment monitoring in the place of the M-CHAT-R or GARS-3 instead of as part of a diagnostic evaluation due to their brevity. Additionally, there is a prorated method of scoring available for individuals with limited or no language that can be used for all forms (Goldstein & Naglieri, 2013).

The Social Responsiveness Scale-Second Edition (SRS-2; Constantino & Gruber, 2012) is another multi-form assessment tool that can be used in autism spectrum disorder evaluations. Like the ASRS, the SRS-2 assesses the social deficits as well as restricted and repetitive behaviors associated with autism for individuals ages 2½ years to adulthood (Constantino & Gruber, 2012). It consists of four different forms that depend on an individual's age: pre-school (2½–4½ years old), school-age (4–18 years old), adult (19 years old and older), and an adult self-report, something that the ASRS does not have. However, it does not contain alternative scoring for those with limited to no language ability like the ASRS. As the ability to use language can significantly impact the interpretation of an individual's social-communicative ability, it is recommended to use a tool like the ASRS that can account for that.

There are also other tools that can be used to gather a parent/caregiver report of symptoms and behaviors that also include measures of comorbid difficulties, like the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT; Matson et al., 2007) or the Autism Spectrum Disorders—Child assessment battery (ASD-C; Matson & González, 2007a, b, c). The BISCUIT can be used with infant/toddler ages 17–37 months, while the ASD-C is intended for children ages 3 years and older. Each measure is comprised of three parts. Like the ASRS, the first parts of the BISCUIT and ASD-C are intended to measure the presence of symptoms of autism and the level of impairment related to each symptom. What is unique to the BISCUIT and ASD-C are the second and third parts. Part two of the BISCUIT assesses disorders and difficulties that commonly co-occur with autism, including attention deficit/hyperactivity disorder, conduct disorder, obsessive-compulsive disorder, specific phobia, tic disorder, and eating difficulties. Part three assesses the child's impairment related to challenging behaviors like stereotypy, aggression, and self-injury. The ASD-C expands upon the content of the BISCUIT's part two and three by assessing for additionally developmentally relevant difficulties, such as depressive symptoms and other internalizing behavior problems.

In conjunction with parent or caregiver report of an individual's behavior, it is vital to incorporate clinical observation of the child or adolescent into a comprehensive evaluation. This goal is often accomplished with the ADOS-2. The Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012), is a semi-structured, standardized observational measure of communication, language, social interactions, repetitive, restricted behaviors and interests, as well as play and imagination. It contains five different modules that could be administered depending on the individual's age and developmental level. It is designed to be used with children from 12 months old to adulthood. Trained individuals select and administer the appropriate module to the child, which often consists of engaging, play-based tasks, and then code the child's behavior following the administration. These codes are then transferred into an algorithm which produces scores with specific autism or autism spectrum cutoffs, with the exception of the Toddler Module in which the algorithm produces ranges of "concern".

The Childhood Autism Rating Scale, Second Edition (CARS-2; Schopler et al., 2010) is a measure of autism symptom severity also based on direct clinical observation. However, the CARS-2 is a questionnaire completed by the clinician after all encounters with the child have occurred, rather than a rating based on one test administration like the ADOS-2. The clinician can also have a caregiver complete an additional CARS-2 questionnaire to provide additional information for their ratings. The CARS has two forms: the Standard Version and the High-Functioning Version. The High Functioning version should be used if the individual in question has average or above cognitive skills, great verbal ability, and fewer social and behavioral difficulties. For both forms, the ratings are summed and transformed to derive a T-score. This resulting T-score for this instrument is interpreted differently than T-scores are typically interpreted. The CARS-2 is based on data from individuals on the spectrum instead of neurotypical children. Instead of an average T-score indicating few to no symptoms of autism spectrum disorder, an average score is indicative of an average level of autism-related symptoms and behaviors. The CARS-2 should not be used in place of the ADOS-2, but it can be helpful to incorporate other behavioral observations from other testing appointments in a standardized fashion in addition to the data gathered by the ADOS-2.

Comprehensive evaluations can also include standardized interview tools, like the Autism Diagnostic Interview-Revised (ADI-R; Rutter et al., 2003) or the Monteiro Interview Guidelines for Diagnosing the Autism Spectrum, Second Edition (MIGDAS-2; Monteiro & Stegall, 2018). The ADI-R is a semi-structured interview that clinicians can use to thoroughly evaluate an individual's developmental history and current behavior. The interview is administered to a parent or caregiver that is familiar with the individual and can provide information about family history, education, previous diagnoses, medications, developmental history, language, social development and play skills, interests, and other relevant behaviors such as aggression, self-injury, and epilepsy. Parents and caregivers can answer questions about their children across a wide age range as long as the child's cognitive age is at least 2 years. One could also use the MIDGAS-2 as part of a comprehensive evaluation. It differs from the ADI-R in that the individual suspected of having autism is included in the process. The assessment includes guidelines for conducting an interview with parents, caregivers, and teachers about the individual's behavior at home and in school and for conducting a sensory-based interview with the individual. The evaluation results in a comprehensive behavioral profile that can be used in conjunction with other assessment procedures to provide a diagnosis and guide treatment planning.

It is also possible to derive evidence for an autism diagnosis from other measures that do not fall in the realm of parent/caregiver report, observational, or interview measures. One such tool is the Developmental Neuropsychological Assessment (NEPSY-II; Brooks et al., 2009). By itself, the NEPSY-II is a comprehensive neuropsychological assessment for children and adolescents, measuring domains such as attention, executive functioning, memory, learning, sensorimotor ability, and visual processing. It also contains two specific subscales assessing social perception that can indicate difficulties associated with autism spectrum disorder: Theory of Mind and Affect Recognition (Narzisi et al., 2013). While not directly created for ASD evaluations, use of these subtests can provide additional objective information about the individual's ability to recognize different emotions and comprehend others' perspectives, intentions, and beliefs. These subtests can be administered alone or as part of a battery of NEPSY-II subtests, especially if the presenting problems indicate comorbid difficulties with attention, memory, or learning.

Video-based diagnostic tools are becoming more commonplace as the need for diagnostic services, especially those that can be provided remotely, increases. The Vanderbilt Kennedy Center's program TELE-ASD-PEDS is one such telehealth tool designed to assess for autism in children under 36 months (Corona et al., 2020). The provider instructs the parent or caregiver to engage in several tasks with their child, which allows the provider to make important behavioral observations regarding potential autism symptoms. NODA is another remote assessment platform that utilizes video to capture the child's behavior in the home available for clinicians to incorporate in their assessment practices (Nazneen et al., 2015). Other platforms have incorporated machine learning and artificial intelligence (AI) into their diagnostic process that are trained to identify autism based on patient data. COGNOA is one such program that utilizes parent/caregiver report questionnaires, home videos of the child, and other health information to provide early identification of autism (Abbas et al., 2018) Needless to say, the use of technology in screening and diagnosis of autism is a burgeoning area that will continue to grow in the hopes that the process can become more efficient and accessible (Table 4.1).

Cognitive

In addition to the assessment of the core features of ASD, there are multiple other domains related to the presentation of ASD, potential comorbid or differential diagnoses, and overall prognostics that should be included in a comprehensive assessment. Recent estimates suggest that approximately 30% of children diagnosed with autism spectrum disorder also have a comorbid intellectual disability (Maenner et al., 2020). The DSM-V listing for ASD includes a specifier for cognitive impairment for this very reason (APA, 2013). Thus, assessment of cognitive ability is vital to a comprehensive assessment of a child suspected of an autism spectrum disorder. It is also important as an intellectual profile can also delineate a child's strengths that are important to the interpretation of the overall assessment results and can be incorporated into treatment. The best tool for cognitive assessment can vary depending

Table 4.1 Autism-specific measures

Measure	Age range	Format
M-CHAT-R (Robins et al., 2009)	16–30 months	Parent/caregiver report rating form
GARS-3 (Gilliam, 2013)	3–22 years	Parent/caregiver or teacher report rating form
ASRS (Goldstein & Naglieri, 2009)	2–18 years	Parent/caregiver or teacher report rating form
SRS-2 (Constantino & Gruber, 2012)	2.5 years and up	Parent/caregiver, teacher, and self-report rating form
BISCUIT (Matson et al., 2007)	17–37 months	Parent/caregiver report rating form
ASD-C (Matson & González, 2007a, b, c)	3–16 years	Parent/caregiver report rating form
ADOS-2 (Lord et al., 2012)	12 months and up	Clinician ratings based on clinical observation of child's behavior
CARS-2 and CARS-2-HF (Schopler et al., 2010)	2 years and up	Clinician ratings based on clinical observation of child's behavior across testing sessions
ADI-R (Rutter et al., 2003)	2 years and up	Semi-structured interview with parent/caregiver
MIDGAS-2 (Monteiro & Stegall, 2018)	Toddlers, children, adolescents, and adults	Guided interview process with caregiver/parent and sensory-based interview with individual
NEPSY-II Theory of Mind and Affect Recognition Subtests (Brooks et al., 2009)	3–16 years	Structured items administered to the child/adolescent
teleASD PEDS (Corona et al., 2020)	Under 36 months	Remote video-based clinical observation of child's behavior
NODA (Nazneen et al., 2015)	NA	Remote video-based clinical observation of child's behavior
COGNOA (Abbas et al., 2018)	NA	Assessment platform that includes remote assessment and video-based observation

on the child's age and language ability; therefore, multiple options are discussed below.

Comprehensive assessment of cognitive ability can be difficult for younger children, especially for those with developmental delays or limited verbal ability. The Bayley Scales of Infant and Toddler Development, Fourth Edition (Bayley & Aylward, 2019) contains a measure of cognitive development for infants and toddlers ages 16 days to 42 months. The assessment contains play-based tasks designed to evaluate the child's visual preference, attention, memory, sensorimotor exploration and manipulation, and concept formation skills compared to their same-aged peers. Similarly, the Mullen Scales of Early Learning (Mullen, 1995) is an assessment system for infants and toddlers for measuring emerging cognitive, language, and motor development. The age range of the Mullen extends to 68 months. However, it has not been updated since its inception, while the Bayley was recently updated and is considered to be a more comprehensive assessment (which also includes measures of receptive/expressive language, motor, social emotional, and adaptive skills). Overall, the Bayley is the preferred cognitive assessment instrument for estimating cognitive ability in infants and toddlers.

Starting at age two, clinicians can use the Stanford-Binet Intelligence Scales, Fifth Edition (SB-V; Roid, 2003) to obtain a more comprehensive picture of the child's intelligence. Unlike the Bayley and Mullens, which are estimates of cognitive development skills, a standardized administration of the SB-V provides a measure of the child's full-scale intelligent quotient (IQ), verbal IQ, and nonverbal IQ. Having a comparison of verbal versus nonverbal ability can provide additional evidence for an autism diagnosis as significant differences between verbal and nonverbal cognitive ability have long been associated with autism spectrum disorder (Ankenman et al., 2014). Additionally, it can provide insight into how the child learns best and what types of activities they will enjoy, which can be helpful for tailoring supportive intervention services after the evaluation.

Regardless of chronological age, some children are unable to complete a verbal cognitive assessment like the SB-V due to verbal language impairments. In these cases, the Leiter International Performance Scale, Third Edition (Roid et al., 2013) can be used to obtain an estimate of nonverbal cognitive ability across the lifespan, starting at age 3. If the child is not old enough to complete the Leiter, the evaluator should instead administer the Bayley scales. The Leiter is a test of nonverbal intelligence and cognitive abilities that was specifically designed for the assessment of individuals with disabilities, such as autism spectrum disorder. Using the Leiter-3 allows the examiner to obtain a measure of an individual's innate intellectual ability regardless of their verbal communication skills. While this assessment does not allow for the examination of a potential fractured IQ profile, it does give the best estimate of intellectual ability in individuals that are nonspeaking or have limited language ability.

There are multiple Wechsler-branded assessments of intelligence that are also commonly used to assess cognitive ability during autism evaluations. The two most commonly used for children and adolescents are the Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (WPPSI-IV; Wechsler, 2012) and the Wechsler Intelligence Scale for Children, and Fifth Edition (WISC-V; Wechsler, 2014). The WPPSI-IV is intended for children ages 2 years and 6 months to 7 years and 7 months, while the WISC-V is used with children and adolescents ages 6 years to 16 years and 11 months. These assessments contain developmentally appropriate subtests that assess the child's verbal comprehension, visual-spatial ability, fluid reasoning skills, working memory, and processing speed. Like the SB-V, the WPPSI-IV and WISC-V provide a measure of nonverbal ability that can be compared to measures of the child's verbal ability. However, the SB-V does not contain a measure of processing speed, which can significantly influence the interpretation of an individual's overall ability. The Wechsler assessments contain the General Ability Index (GAI) that separates these abilities from the overall full-scale IQ in the case that these abilities are significantly influencing their scores. Additionally, the WPPSI and WISC can be used to derive a Cognitive Proficiency Index, a measure of working memory, and processing speed. This index may be indicative of comorbid attention difficulties, which are discussed later in this chapter. While the SB-V provides a better comparison of verbal versus nonverbal ability, it may be worthwhile to administer a Wechsler test instead if attentional difficulties are a concern. However, if the child has limited to no language ability, the evaluator should instead administer the Leiter-3 and utilize the supplementary attentional and memory subtests that are a part of that instrument.

The Wechsler Adult Intelligence Scale, Fourth Edition (WAIS-IV; Wechsler, 2008) is normed for ages 16–90, meaning that it technically encompasses part of the adolescent age range. Unlike the WPPSI-IV and WISC-V, the WAIS-IV does not contain measures of nonverbal intelligence or cognitive proficiency and is not recommended. Similarly, some may consider using the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011) for this same age range but should considered this measure with even greater caution. The WASI gives a simplified measure of verbal and nonverbal ability comprised of only four subtests. While it can give an estimate of cognitive ability, the WASI-II is unable to provide information about other cognitive areas such as processing speed and working memory that are significant in the interpretation of evidence toward or against a diagnosis of autism spectrum disorder (Table 4.2).

Table 4.2 Cognitive assessment measures

Measure	Age range	Format
Bayley Cognitive Subtest (Bayley & Aylward, 2019)	16 days to 42 months	Structured items administered to the child and caregiver report
Mullen (Mullen, 1995)	1–68 months	Structured items administered to the child
SB-V (Roid, 2003)	2–85+ years	Structured items administered to the child
Leiter-3 (Roid et al., 2013)	3–75+ years	Structured items administered to the child nonverbally
WPPSI-IV (Wechsler, 2012)	2.5–7 years, 7 months	Structured items administered to the child
WISC-V (Wechsler, 2014)	6–16 years, 11 months	Structured items administered to the child
WAIS-IV (Wechsler, 2008)	16–90 years, 11 months	Structured items administered to the adolescent
WASI-II (Wechsler, 2011)	16–90 years, 11 months	Structured items administered to the adolescent

Adaptive

Adaptive behaviors are those behaviors that involve conceptual, social, and practical skills of which enable a person to manage their environment in a way that promotes success. These behaviors may include daily living skills, social skills, communication skills, and motor skills. Those with an autism spectrum disorder may exhibit significant deficits within these areas such that they may struggle to take care of themselves throughout their daily lives. They may also have difficulties interacting with others and maintaining conversation which aligns with deficits in these skills. For comprehensive autism evaluations, information regarding adaptive behavior is typically gather via parent report, teacher report, and self-report measures. Including an assessment of adaptive behaviors can help to identify how the individual engages with others, how well they are able to independently take care of themselves, and how they keep themselves safe.

At present, there are two main assessment tools that are recommended for use in the evaluation of adaptive skills: The Adaptive Behavior Assessment System-Third Edition (ABAS-3; Harrison & Oakland, 2015) and the Vineland Adaptive Behavior Scale- Second Edition (Vineland-3; Sparrow et al., 2016). The ABAS-3 (Harrison & Oakland, 2015) consists of a parent/caregiver report measure, a teacher/daycare report measure, and a self-report measure. This assessment encompasses a wide age range with norms that range from birth up to 89 years old. This measure assesses the conceptual, social, and practical domains of adaptive skills and includes 11 different skill areas such as communication, community use, functional academics, health and safety, home or school living, leisure, motor, self-care, self-direction, social, and work. These items focus on everyday activities required to care for oneself, interact with others effectively and independently, and meet environmental demands, which can be a difficult for individuals on the spectrum.

The Vineland-3 (Sparrow et al., 2016) is similar to the ABAS-3 in both structure and content. Like the ABAS-3, the Vineland-3 assesses the different domains of adaptive behavior including communication, daily living skills, and socialization. The primary differences between these measures are the inclusion of a semi-structured interview form and the exclusion of a self-report form. The interview form is meant to assess the adaptive behaviors of those from birth to 90 years of age where either a parent or caregiver is interviewed regarding the adaptive behaviors of the individual being evaluated. While the Vineland-3 lacks a self-report form, the ABAS-3 self-report is intended for ages 16–89, meaning that it would not likely be helpful to include unless the evaluation was for an older adolescent. Overall, both tools are adequate for the assessment of adaptive behaviors in children and adolescents across multiple raters and multiple settings for the purpose of diagnosis and to delineate target behaviors for intervention services.

While no longer a recommended measure of assessment for adaptive behaviors, it is important to mention the Scales of Independent Behavior-

Table 4.3 Adaptive behavior assessment measures

Measure	Age range	Format
ABAS-3 (Harrison & Oakland, 2015)	Birth to 89 years and 11 months	Parent/caregiver, teacher/daycare provider, and adult self-report rating forms
Vineland Adaptive Behavior Scale (Sparrow et al., 2016)	Birth to 90 years	Semi-structured interview, parent/caregiver rating form, and teacher rating form

Revised (SIB-R; Bruininks et al., 1996) as it has been used historically as an integral part of diagnostic evaluations for autism. This measure was intended to assess functional independence and adaptive functioning across different settings from birth to 80 years old. However, the SIB-R has not been updated since its release in 1996 and includes many outdated adaptive tasks/skills that are not expected of individuals today. Therefore, it is strongly recommended that this measure no longer be used in the field (Table 4.3).

Speech/Language

Impairments in speech, language, and social communication are core features of ASD. The range of verbal abilities is extensive, as are the idiosyncrasies in language differences common to those with ASD. These differences in verbal abilities or characteristics include speech and language delays, echolalia, idiosyncratic speech, and a host of other language differences (Mody & Belliveau, 2013). Many with ASD have limited verbal communication with about 30% being deemed nonverbal after failing to develop phrase speech by 9 years of age (Anderson et al., 2007). While later speech acquisition does occur at higher rates than previously thought (Pickett et al., 2009), speech acquisition after middle childhood is rare and of those that have not developed phrase speech by 4 years of age, higher nonverbal IQ was the biggest indicator of differentiating those that will develop phrase and/or fluent speech later in childhood (Wodka et al., 2013). Other common speech differences include odd intonation or monotone speech, other prosody differences, immediate and delayed echolalia, and articulation issues often related to apraxia and other oral-motor impairments. Some differences observed are within the acquisition of language with some individuals exhibiting deficits in vocabulary and others exhibiting advanced vocabulary, though both tend to have limitations in abstract and social-emotional language (e.g., pronoun reversals, difficulties labeling emotions, relationships, and abstract concepts). While these differences are not specific to ASD and are observed in typical development and other neurodevelopmental disorders (Gernsbacher et al., 2016), the pervasiveness and unique characteristics of these differences can often serve as key indicators of ASD and warrant comprehensive assessment.

The two most common and appropriate tests for this population for a broad comprehensive assessment of speech-language skills are the Preschool Language Scales-fifth edition (PLS-5; Zimmerman et al., 2011) and the Clinical Evaluation of Language Fundamentals-fifth edition (CELF-5, Wiig et al., 2013). Both of these assessments include a broad assessment of receptive and expressive language abilities and are the foundation of a strong comprehensive speech-language assessment. Both tests exhibit sufficient sensitivity and specificity in identifying receptive and expressive language deficits and are further useful in identifying deficits and differences common in ASD.

The PLS-5 can be used with children from birth to 7 years of age and is a play-based assessment. It produces two broad standard scores of receptive auditory comprehension and expressive communication. Additionally, this test provides information that not only includes analysis of semantics and language structure but also provides useful information on attention, use of gestures, social communication, vocal development, play, as well as emergent literacy skills. The test also provides an articulation screener and is available in both English and Spanish. For older children, the CELF-5 has been normed for individuals 5–21 years of age and is a more structured assessment than the PLS-5. The CELF-5 includes 16 individual subtests that can be selected based on the referral question or clinical concerns. Like the PLS-5, it also produces broad standard scores for receptive and expressive communication skills (in addition to a core language score) as well as assessing sentence structure/content and language memory/attention. Additionally, the CELF-5 includes a pragmatics observation checklist that can be used as a screener for pragmatic deficits common in ASD. Lastly, the CELF-5 also includes supplementary tests assessing reading comprehension and a structured writing subtest.

A third option commonly used for infants and toddlers is the Bayley (Bayley & Aylward, 2019) subtests of receptive and expressive language, which is often used when administering the other components of the Bayley (e.g., cognitive subtest). As noted earlier, the Bayley scales can be used with infants as young as days through toddlers up to 42 months of age. These subtests incorporate structured items administered to the child supplemented with behavioral observations of language use during the testing session through play-based interactions and tasks.

Because children with ASD often struggle with the pragmatic and social use of language, oftentimes it is helpful to assess these areas of language development in addition to the broad information provided by the PLS-5 and CELF-5. Two measures commonly used for a deeper assessment of a broad range of language skills, and include good measures of pragmatic language use, are the Comprehensive Assessment of Spoken Language, second edition (CASL-2; Carrow-Woolfolk, 2017) and the Oral and Written Language Scales, second edition (OWLS-II; Carrow-Woolfolk, 2011). Both of these measures assess four scales of language structure (i.e., lexical/semantics, syntax, supralinguistics, and pragmatics) and can be used with individuals aged 3–21 years. The OWLS-II assesses these four languages scales across the areas of listening comprehension, oral expression, reading comprehension, and written expression whereas the CASL-2 is strictly a measure of spoken language. However, the CASL-2 has several subtests that assess areas of language that children with ASD commonly struggle with including non-literal language, pragmatic language, and idiomatic language. Assessment of these language areas can be helpful in identifying needed supports in the social use of language.

More recently developed assessments of pragmatic language, such as the Clinical Assessment of Pragmatics (CAPs; Lavi, 2019) have started to incorporate video-based components to further assess the complex nature of pragmatic language use. Normed for use with children between 7 and 18 years of age, this unique assessment provides a more thorough assessment of pragmatic and social language skills and development including awareness of basic social routines, reading context and nonverbal cues and the use of these same skills, and expressing emotions. While the normative sample does include children with autism, it would not be appropriate for an individual with a comorbid intellectual disability or severe language impairment. The measure provides information that can inform many areas of needed supports and aid in the development of pragmatic goals (Table 4.4).

Restricted and Repetitive Behaviors and Interests

Restricted and repetitive behaviors and interests are one of the hallmark diagnostic criteria of autism spectrum disorder. These behaviors and interests may consist of insistence on sameness, becoming fixated on certain objects, having a heightened or lower sensitivity for different senses, and repetitive movements like spinning or rocking. Although RRBIs are a core feature of autism spectrum disorders, this domain is not specific to autism. There are other disorders such as obsessive-compulsive disorder that also feature RRBIs which makes it critical to assess for differing sensory abnormalities. When assessing restrictive and repetitive behaviors it is also important to consider compensatory behaviors, which are behaviors that allow the individual to mask or hide autism characteristics from others. Compensatory or masking behaviors can make restrictive and repetitive behaviors look different

Table 4.4 Speech/language assessment measures

Measure	Age range	Format
Bayley Receptive/Expressive Language Subtests (Bayley & Aylward, 2019)	16 days to 42 months	Structured items administered to the child, observation, and caregiver report
PLS-5 (Zimmerman et al., 2011)	Birth to 7 years	Structured items administered to the child
CELF-5 (Wiig et al., 2013)	5–21 years	Structured items administered to the child/adolescent
CASL-2 (Carrow-Woolfolk, 2017)	3–21 years	Structured items administered to the child/adolescent
OWLS-II (Carrow-Woolfolk, 2011)	3–21 years	Structured items administered to the child/adolescent
CAPs (Lavi, 2019)	7–18 years	Structured video-based items administer to the child/adolescent

to others and may make them difficult to understand. Because compensatory behaviors could alter how these RRBIs may appear, it is best to use a self- or parent report and interviews to accurately capture how they may exist. When assessing for repetitive and restrictive behaviors and interests, it can be helpful to use a multi-method technique, meaning that the clinician should use both observation and other sources of information whether it be self- or parent reports. This may be especially relevant when assessing adults as the measures specific to adulthood are limited.

There are few different tools that can be used to assess RRBIs in both children and adolescents. One such tool used to measure repetitive and restrictive behaviors is the Repetitive Behavior Scale for Early Childhood (RBS-EC; Wolff et al., 2016). This report measure is designed for children from 17 months to 7 years of age and can be completed by parents, caregivers, and teachers. The RBS-EC is intended to understand differences across a broad range of repetitive and restrictive behaviors while focusing on quantifying the dimensions of these behaviors. A recent psychometric study by Lachance et al. (2021) has provided additional normative data regarding age and gender which can be used for comparison during the evaluation process. The Repetitive Behaviors Scale-Revised (RBS-R; Bodfish et al., 1999) is a similar measure suited for individuals from 6 to 17 years of age. This measure assesses stereotyped behavior, self-injurious behaviors, compulsive behaviors, routine behavior, sameness behaviors, and restricted behaviors and is also typically completed by parents or caregivers of the child. Individuals answer questions about repetitive movements, special interests, and insistence on sameness. These questions help to highlight the different behaviors that individuals engage in that they may be masking when in the presence of others.

It is important to recognize that the RBS-EC and RBS-R are strictly meant to assess restrictive and repetitive behaviors and are not autism-specific. While these measures may capture important information, it is essential to understand sensory abnormalities as well to truly understand RRBIs. Thus, it is vital to measure for differences in sensory processing when considering a diagnosis of ASD.

Sensory Abnormalities

Similar to RRBIs**,** sensory abnormalities are a core feature of autism spectrum disorder but are not limited to an ASD diagnosis. While many of the measures discussed include some component assessing sensory abnormalities (usually as an ASD specific diagnostic symptom), few measures have been developed specifically for the aim of assessing sensory abnormalities. One such measure is the Sensory Profile 2 (Dunn, 2014). This caregiver/teacher report measure can be used with children from birth through 14 years of age and assesses sensory abnormalities across sensory processing modalities (i.e., auditory, visual, touch, movement, body position, and oral sensory) and behavior (i.e., conduct, social-emotional, and attentional) and categorizes these behaviors according to "quadrants", which assess the degree to which their sensory behaviors fall under one of four categories. These quadrants include seeking/seeker, avoiding/avoider, sensitivity/sensory, and registration/bystander which are based on two factors; the degree to which individuals actively self-regulate (with seekers and avoiders engaging in active self-regulation) and the threshold for which individuals notice sensory stimuli (with sensors and avoiders having a low threshold for noticing sensory stimuli). The scores produced by the Sensory Profile 2 are percentile ranges and a 5-point Likert scale ranging from much less than others to much more than others. Unfortunately, the measure does not provide scaled or standard scores and exhibits weak psychometric properties; however, the qualitative information gathered from this measure can be helpful in better characterizing the sensory abnormalities of the assessed individual to aid in the development of recommendations and intervention planning.

Psychological Comorbidities

Attention

One comorbidity with autism is difficulties with attention. Particularly, those with autism can have comorbid attention-deficit/hyperactivity disorder (ADHD). This disorder is defined by symptoms of inattention, hyperactivity, and/or impulsivity. In order to assess for ADHD within autistic individuals, caregiver and teacher report measures are available, such as the Behavior Assessment System for Children, 3rd Edition (BASC-3; Reynolds & Kamphaus, 2015) and the Conners-3 (Conners, 2008), for understanding these symptoms within an individual better. Measures can also be administered to the child, depending on their age. The primary behavioral measures that can be used with children for attention include the Conners Continuous Performance Test, 3rd Edition (Conners CPT-3; Conners, 2014), Conners Continuous Auditory Test of Attention (Conners CATA; Conners, 2014), Conners Kiddie Continuous Performance Test 2nd Edition (Conners K-CPT 2; Conners, 2006). The Conners CPT-3 and Conners CATA are for individuals 8 years old and older while the Conners K-CPT-2 is for children between the ages of 4 years and 7 years 11 months. In previous research, caregiver report measures such as the BASC-3 and Conners-3 have been able to differentiate between symptoms of ASD and ADHD while the Conners CPT-3 had more difficulty differentiating between these symptoms (Braconnier & Siper, 2021).

Feeding Problems

Children with autism have significantly more feeding problems than those without autism. Feeding problems that children can have include food selectivity, rapid eating, chewing difficulties, and food refusal. In order to understand these difficulties more, several measures exist to assess for them including the Brief Autism Mealtime Behavior Inventory (BAMBI; Lukens & Linscheid, 2008) and the Screening Tool of feeding Problems (STEP; Matson & Kuhn, 2001) that has been modified for use with children (STEP-CHILD; Seiverling et al., 2011). The BAMBI has been used with children 3–8 years old while the STEP-CHILD has been used with children 2–18 years old. Both of these measures are caregiver reports and provide clarity to the child's specific difficulties regarding feeding.

Sleeping Problems

Many autistic children have difficulties with sleep. This can include difficulty falling asleep, difficulty staying asleep, early waking, parasomnias, and daytime sleepiness. One way to measure sleep problems in children with autism is keeping a sleep diary in which antecedents, behavior, and consequences surrounding sleep difficulties are recorded. Through this, one would be able to better understand possible causes in the child's environment. Additional quantitative measures of sleep have been previously used to understand sleep difficulties within autistic children. These include the Children's Sleep Habits Questionnaire (CSHQ; Owens et al., 2000), the Behavioral Evaluation of Disorders of Sleep (BEDS; Schreck, 1998; Schreck et al., 2003) the

Family Inventory of Sleep Habits (FISH; Malow et al., 2009). The CSHQ has been used with children with autism from 2 to 18 years old. The BEDS has been used with 5- to 12-year-olds with autism. The FISH has been used with autistic children between the ages of 4–10 years.

Executive Functioning

Another common concern for autistic children is difficulties with executive functioning, which is broadly defined as inhibition, cognitive flexibility, impulse control, working memory, and planning. Executive functioning deficits are thought to be associated with difficulty with behavior regulation, affective regulation, and meta-cognition which negatively impacts one's ability to cognitively manage and execute tasks (Berenguer et al., 2018). Several measures exist that can examine these different aspects of executive functioning within autistic individuals. One such measure is the Delis-Kaplan Executive Functioning System (D-KEFS; Delis et al., 2001). The D-KEFS, used for ages 16 years old to 89 years old, has various tests that can be used to measure different aspects of executive functioning, such as cognitive flexibility, response inhibition, and planning. Another measure for executive functioning is the previously mentioned NEPSY-II, which can be administered to children aged 3–16 years old. The NEPSY-II measures six different domains, one of which is executive functioning.

Challenging/Disruptive Behaviors

Challenging and disruptive behaviors occur in children with autism at a higher rate than neurotypical children. These behaviors can include aggression, self-injury, and disruption to their environment. Often these behaviors are considered to be behaviors that can cause harm to the child or others, are not culturally or socially acceptable, and/or negatively affect their life or education. One measure of these behaviors is the Behavior Problems Inventory (BPI-01; Rojahn et al., 2001) which has been used with children aged 14 years and above. Another measure is the PDD Behavior Inventory (Cohen et al., 2003). This has been used with children with autism between the ages of 2–12 years. One other way to assess challenging and disruptive behaviors that can be used with children of any age is conducting a functional behavior assessment (FBA). An FBA involves gathering information about the antecedents of a behavior, details about the behavior itself, and consequences for the behavior. Additionally, challenging behaviors can also be assessed through the BISCUIT and ASD-C measures which were previously discussed.

Diagnostic Considerations

In addition to evaluation of the previous domains, there are other common areas that are important to consider during evaluation and the interpretation of results from the evaluation.

Regression of Skills

There are generally four patterns of development that have been identified in children that are identified as autistic (Pearson et al., 2018). Some children exhibit autism symptoms within the first year of life. Others make developmental progress, but later experience a significant plateau in their development. Unfortunately, some children will attain developmental milestones but later regress or lose those skills. Other children that experience delays in their abilities from the beginning may also exhibit regression in certain skill areas. Previous research reports that the latter two patterns typically occur around 21 months of age, ranging from 15 to 30 months (Barger et al., 2013). Parents may report regression of their child's language skills, social skills, or a mixture of both. Documenting this regression is key as it provides context to the child's current delays and areas of impairment as well as important targets for intervention. For older children and adolescents, it also provides additional historical evidence for an autism spectrum disorder diagnosis.

Age Milestone Transitions

Individuals on the spectrum sometimes have difficulties with age-related transitions, such as entering kindergarten, transitioning to middle school, or transitioning to high school. Distress and impairment related to their ASD and other behaviors may worsen during these transitional periods. Evaluations of children undergoing these important transitions should include recommendations for better management of these transitions, such as providing increased occupational therapy support and school-based interventions (Davis, 2009; Marsh et al., 2017).

Compensatory Behaviors

One challenge of evaluating for autism, especially in older children, is the development of compensatory behaviors that hide or mask symptoms of autism. Compensatory behaviors, as it pertains to autism, is when an individual learns, whether consciously or subconsciously, to hide behaviors that may be considered socially unacceptable and compensate with behaviors that are viewed as socially acceptable; this is also often referred to as masking or camouflaging behaviors. For example, an individual with autism may learn to make eye contact, imitate facial expressions, or have phrases or jokes that are prepared for social conversations. These behaviors aid the individual in appearing socially competent. However, these compensatory behaviors can be taxing on the individual, potentially leading to diminished well-being, possibly due to stress associated with performing behaviors that do not come naturally to the person or from attempting to determine what behavior is appropriate to a situation. Individuals with compensatory behaviors tend to still have social issues, particularly with maintaining friendships, despite their own compensatory behaviors. Compensatory behaviors have also been found to be more prevalent in females than males, which can contribute to the disparate diagnostic rates (Ratto et al., 2018). Taken together, individuals with autism, especially females, may develop compensatory behaviors that could result in them resting below the diagnostic threshold for autism but still experiencing autism-related difficulties (Livingston et al., 2019).

Barriers to Diagnosis

It is believed that ASD is equally distributed across all races, ethnicities, and socioeconomic statuses. However, the actual reported prevalence rates have been found to differ across races. More specifically, communities of color typically have a lower prevalence rate of ASD than other communities (Baio et al., 2018; Center for Disease Control and Prevention, 2016; Tek & Landa, 2012). It is suggested that this is due to a lack of knowledge about autism and less access to healthcare resources within minority communities leading to fewer diagnoses (Tek & Landa, 2012). It has been found that socioeconomic status plays a role in these differences in prevalence rates as well (Durkin et al., 2017). This finding suggests that ASD is frequently underreported in racial and ethnic minorities from a lower socioeconomic status. Additionally, unique barriers exist for families that are of low income and/or minority backgrounds that create difficulties in receiving a full diagnostic evaluation. These barriers include having limited follow-ups scheduled after a positive screening for ASD due to lack of access to phones or higher levels of stigma associated with a diagnosis of autism (Khowaja et al., 2015). In addition to these barriers, it is often quite costly to obtain a diagnostic evaluation for autism, not only for the cost of the evaluation itself but for all costs associated with receiving that diagnosis (e.g., transportation to get the diagnosis, childcare for siblings, caregivers having to take time off work). Living in a rural area can also limit accessibility for diagnostic evaluation services. Not only are there fewer available options for families to receive these services, but the distance needed to travel to obtain these services is substantially higher and more costly. When there is limited access to proper resources, a diagnosis for autism may be missed or delayed. These barriers for an early diagnosis of autism are then further compounded and complicated by challenges when attempting to diagnose autism later in childhood or later in life.

Comorbidities

An additional factor to consider when diagnosing autism is the high occurrence of co-morbid disorders (i.e., two or more disorders that co-occur within an individual). Individuals with autism tend to present with high rates of co-occurring disorders, including psychiatric disorders like anxiety, depression, social anxiety, and obsessive-compulsive disorder as well as medical conditions, such as sleep disorders, gastrointestinal disorders, and epilepsy (Ming et al., 2008). These high rates of co-morbidities can contribute to the difficulty of parsing apart what is autism and what is another disorder. A particularly noteworthy co-occurring disorder is social anxiety disorder, as both autism and social anxiety disorder tend to present similarly (e.g., aversion to social situations and lack of eye contact). While these behaviors may be present in both disorders, it is possible for a child to be diagnosed with either of these disorders, both, or neither. In order to differentiate between autism and another disorder, a clinician must understand the reasons behind the symptoms presented as well as have a thorough understanding of the criteria for these disorders and how they could present within an individual.

Recommendations and Treatment Planning

Once the results of the evaluation have been aggregated and interpreted, the clinician should utilize this information for the creation of tailored recommendations and treatment planning. There are several types of recommendations that are common to comprehensive testing reports for autism, including in-home supports, speech therapy, occupational therapy, ABA services, school-based recommendations, and even more depending on the child's needs. However, it is important to incorporate not only the data regarding the child's weaknesses but also the available information of their strengths when recommending these services. The individual's strengths can be leveraged to address their weaknesses in a more empowering and efficient way. For example, a child that struggles with language but excels in visual processing, as determined by cognitive and language assessment can be supported with the use of visual schedules to aid transitions at home and in school.

Feedback

Upon the completion of a diagnostic evaluation for autism, a feedback session is typically conducted. How this feedback process is completed can vary across settings, but there are key parts of the feedback session that should be included. During the feedback, a clinician should, at minimum, discuss the findings of the assessments, the diagnoses, and recommendations for the child and their family (Austin et al., 2012). However, feedback should not be limited to just this final session and should extend beyond. Providers should be continuously providing feedback to the caregiver throughout the evaluation session(s), such as information about the evaluation process and their observations of the child's behavior. Doing so can help prepare a family for this final feedback session. Withholding information about a potential diagnosis during the evaluation process, even if a diagnosis is not yet fully established, can be harmful to the final feedback session. It is important to consider the family's cultural background when providing feedback as this may contribute to their understanding and acceptance of the diagnosis and recommendations. Before the final session that is devoted to providing feedback, consider with the caregivers who should attend. It may or may not be helpful to have family members or other providers of the child present, depending on each family's situation. Also, the presence of young children during a feedback session has the potential to be disruptive or take the caregiver's focus away from the feedback session. During the feedback session, the clinician should inquire about any changes that have occurred with the child since their last session, acknowledge how the family contributed to the evaluation process, and provide them with an overview of the feedback process (Austin et al., 2012). Providing caregivers who attend the feedback session with written material, such as an evaluation report, and focusing on the child's strengths are recommended. Always using clear language and allowing families time to process a diagnosis is helpful, as an autism diagnosis can be overwhelming for many families. For more information about conducting feedback sessions for autism diagnostic evaluations, we recommend the video series, handbook, and other resources created by Autism Speaks regarding the subject. These videos can be found at https://www.autismspeaks.org/tool-kit/atnair-p-guide-providing-feedback-families-affected-autism (Autism Speaks, n.d.).

Future Directions

While there have been great strides made in the field of diagnostics for autism spectrum disorders, there is always more work to be done. Clinicians and researchers have noted several areas in which current assessment literature and practices need to focus their efforts. For example, the field of diagnostics continues to search for new ways to increase the accessibility and efficacy of autism evaluations. As discussed earlier, multiple efforts are being made to incorporate video observation tools and telehealth in the diagnostic process. There is also interest in potential biomarkers that can be used to identify autism (Frye et al., 2019). While the current diagnostic process is heavily based on clinical observation of behaviors and caregiver report, biomarkers could provide biological evidence for autism and improve rates of early diagnosis. However, this research is in its infancy and will require continued research efforts in order to be integrated into evaluation procedures.

For current assessment methods, there is a need for the development of better tools for the diagnostic domains mentioned previously in the chapter. Assessment of RRBIs and sensory abnormalities in particular are lacking. The tools that do exist are often limited in their psychometric utility, age range, or format. In general, many autism assessments are limited to parent/caregiver report due to the inability of children and adolescents to report on their own developmental history and some behaviors. Current evaluative tools and those to be developed in the future should continue to expand their utility to older children and adolescents, increase their psychometric properties, and integrate multiple formats of assessment data to provide a comprehensive picture of the individual's symptoms and behaviors.

There is also important work to be done concerning autism and gender. The DSM-V criteria for autism spectrum disorder drive the creation of diagnostic instruments for evaluation; however, these criteria may not capture the presentation of ASD symptoms spanning the entire spectrum of gender. Historically, autism has been thought to be present more often in individuals assigned male at birth than those assigned female at birth, with a 4–1 ratio of boys to girls (Maenner et al., 2020). While this difference in diagnostic rates has remained stable over time, there are questions as to why there continues to be such a robust sex difference. The DSM criteria at present are not sex- or gender-specific despite potential differences in development for boys and girls on the spectrum (Rivet & Matson, 2011). Future research delineating these differences may provide evaluators with sex- and gender-specific consideration when evaluating for autism spectrum disorders. Additionally, a number of individuals on the spectrum are gender diverse, meaning that they identify outside of the gender binary (George & Stokes, 2018; de Vries et al., 2010). The field is just beginning to address this cooccurrence and what it means for the presentation of ASD symptoms and the evaluation process.

While this chapter is focused on the assessment of children and adolescents with autism spectrum disorder, there is burgeoning interest in increasing diagnostic efficacy for adults. Many adults with autism may go undiagnosed for a number of reasons including the barriers to diagnosis previously mentioned, not meeting criteria for previous conceptions of autism, less concern from parents about developmental issues, compensatory behaviors, and more (Cage & Troxell-Whitman, 2019; Davidovitch et al., 2015; Durkin et al., 2017; Lai & Baron-Cohen, 2015; Maenner et al., 2020). As such, the field will need to continue its efforts to improve the evaluation process beyond childhood and adolescence.

Conclusion

As we conclude this chapter, we hope it has become clear that the evaluation process for autism spectrum disorder can and should be comprehensive. Assessment batteries should incorporate a multi-modal assessment approach, including parent/caregiver reports, teacher report if applicable, clinical observation measures, and standardized assessment measures. Of these methods, an evaluator should assess autism-specific symptoms and behavior, cognitive ability, adaptive behavior, speech and language ability, RRBIs, sensory abnormalities, and other potential comorbid disorders or difficulties. These domains and additional diagnostic considerations will give the evaluator an overall picture of whether the individual being evaluated meets criteria for an autism spectrum disorder and receive the support services they need.

References

Abbas, H., Garberson, F., Glover, E., & Wall, D. P. (2018). Machine learning approach for early detection of autism by combining questionnaire and home video screening. *Journal of the American Medical Informatics Association, 25*(8), 1000–1007.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, D. K., Lord, C., Risi, S., DiLavore, P. S., Shulman, C., Thurm, A., Welch, K., & Pickles, A. (2007). Patterns of growth in verbal abilities among children with Autism Spectrum Disorder. *Journal of Consulting and Clinical Psychology, 75*(4), 594–604.

Ankenman, K., Elgin, J., Sullivan, K., Vincent, L., & Bernier, R. (2014). Nonverbal and verbal cognitive discrepancy profiles in Autism Spectrum Disorders: Influence of age and gender. *American Journal on Intellectual and Developmental Disabilities, 119*(1), 84–99.

Austin, H., Katz, T., Paul, J., & Reyes, J. P. (2012, September). *A clinician's guide to providing effective feedback to families affected by autism*. http://aspergers.ca/wp-content/uploads/media-library/article/pdfs/a_clinicians_guide_to_delivering_feedback_manual.pdf

Autism Speaks. (n.d.). *ATN/AIR-P guide to providing feedback to families affected by autism*. Autism Speaks. Retrieved December 30, 2021, from https://www.autismspeaks.org/tool-kit/atnair-p-guide-providing-feedback-families-affected-autism

Baio, J., Wiggins, L., Christensen, D. L., Maenner, M. J., Daniels, J., Warren, Z., Kurzius-Spencer, M., Zahorodny, W., Rosenberg, C. R., White, T., & Durkin, M. S. (2018). Prevalence of autism spectrum disorder among children aged 8 years—Autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *MMWR Surveillance Summaries, 67*(6), 1.

Barger, B. D., Campbell, J. M., & McDonough, J. D. (2013). Prevalence and onset of regression within autism spectrum disorders: A meta-analytic review. *Journal of Autism & Developmental Disorders, 43*(4), 817–828.

Bayley, N., & Aylward, G. P. (2019). *Bayley scales of infant and toddler development* (4th ed.). [Measurement instrument]. NCS Pearson.

Berenguer, C., Miranda, A., Colomer, C., Baixauli, I., & Roselló, B. (2018). Contribution of theory of mind, executive functioning, and pragmatics to socialization behaviors of children with high-functioning autism. *Journal of Autism and Developmental Disorders, 48*(2), 430–441.

Bodfish, J. W., Symons, F., & Lewis, M. (1999). *The repetitive behavior scale: Test manual*. Western Carolina Center Research Reports.

Braconnier, M. L., & Siper, P. M. (2021). Neuropsychological assessment in autism spectrum disorder. *Current Psychiatry Reports, 23*(10), 1–9.

Brooks, B. L., Sherman, E. M., & Strauss, E. (2009). NEPSY-II: A developmental neuropsychological assessment. *Child Neuropsychology, 16*(1), 80–101.

Bruininks, R. H., Woodcock, R. W., Weatherman, R. F., & Hill, B. K. (1996). *SIB-R—Scales of Independent behavior—Revised: Comprehensive manual*. Riverside.

Cage, E., & Troxell-Whitman, Z. (2019). Understanding the reasons, contexts and costs of camouflaging for autistic adults. *Journal of Autism and Developmental Disorders, 49*(5), 1899–1911.

Carrow-Woolfolk, E. (2011). *OWLS-II: Oral and written language scales*. Western Psychological Services.

Carrow-Woolfolk, E. (2017). *CASL-2: Comprehensive assessment of spoken language-2*. Western Psychological Services.

Center for Disease Control and Prevention. (2016). Prevalence and characteristics of Autism Spectrum Disorder among children aged 8 years—Autism and developmental disabilities monitoring network, 11 sites, United States, 2012. *Morbidity and Mortality Weekly Report: Surveillance Summaries, 65*(3), 1–23. https://doi.org/10.15585/mmwr.ss6503a1

Cohen, I. L., Schmidt-Lackner, S., Romanczyk, R., & Sudhalter, V. (2003). The PDD Behavior Inventory: A rating scale for assessing response to intervention in children with pervasive developmental disorder. *Journal of Autism and Developmental Disorders, 33*(1), 31–45.

Conners, C. (2006). *Conners' kiddie continuous performance test*. Multi-Health Systems.

Conners, C. K. (2008). *Conners third edition (Conners 3)*. Western Psychological Services.

Conners, K. (2014). *Conners continuous performance test 3rd edition and Conners continuous auditory test of attention: Manual*. Multi Health Systems.

Constantino, J. N., & Gruber, C. P. (2012). *Social responsiveness scale: SRS-2*. Western Psychological Services.

Corona, L., Hine, J., Nicholson, A., Stone, C., Swanson, A., Wade, J., Wagner, L., Weitlauf, A., & Warren, Z. (2020). *TELE-ASD-PEDS: A telemedicine-based ASD evaluation tool for toddlers and young children*. Vanderbilt University Medical Center. https://vkc.vumc.org/vkc/triad/tele-asd-peds

Davidovitch, M., Levit-Binnun, N., Golan, D., & Manning-Courtney, P. (2015). Late diagnosis of Autism Spectrum Disorder after initial negative assessment by a multidisciplinary team. *Journal of Developmental & Behavioral Pediatrics, 36*(4), 227–234.

Davis, N. M. (2009). Autism and transition: A nonlinear dynamics systems perspective. *Journal of Occupational Therapy, Schools, & Early Intervention, 2*(3–4), 221–237.

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *The Delis-Kaplan executive function system: Examiner's manual*. The Psychological Corporation.

de Vries, A. L., Noens, I. L., Cohen-Kettenis, P. T., van Berckelaer-Onnes, I. A., & Doreleijers, T. A. (2010). Autism spectrum disorders in gender dysphoric children and adolescents. *Journal of Autism and Developmental Disorders, 40*(8), 930–936.

Dunn, W. (2014). *Child sensory profile–2 user's manual*. Pearson.

Durkin, M. S., Maenner, M. J., Baio, J., Christensen, D., Daniels, J., Fitzgerald, R., Imm, P., Lee, L., Schieve, L. A., Braun, K. V. N., Wingate, M. S., & Yeargin-Allsopp, M. (2017). Autism Spectrum Disorder among US children (2002–2010): Socioeconomic, racial, and ethnic disparities. *American Journal of Public Health, 107*(11), 1818–1826. https://doi.org/10.2105/ajph.2017.304032

Frye, R. E., Vassall, S., Kaur, G., Lewis, C., Karim, M., & Rossignol, D. (2019). Emerging biomarkers in autism spectrum disorder: A systematic review. *Annals of Translational Medicine, 7*(23), 792.

George, R., & Stokes, M. A. (2018). A quantitative analysis of mental health among sexual and gender minority groups in ASD. *Journal of Autism and Developmental Disorders, 48*(6), 2052–2063.

Gernsbacher, M. A., Morson, E. M., & Grace, E. J. (2016). Language and speech in autism. *Annual Review of Linguistics, 2*(1), 413–425. https://doi.org/10.1146/annurev-linguistics-030514-124824

Gilliam, J. E. (2013). *Gilliam autism rating scale–third edition (GARS-3)*. Pro-Ed.

Goldstein, S., & Naglieri, J. A. (2009). *Autism spectrum rating scales (ASRS)*. Multi-Health System.

Goldstein, S., & Naglieri, J. A. (2013). *Autism spectrum rating scales: ASRS*. MHS.

Harrison, P., & Oakland, T. (2015). *Adaptive behavior assessment system (ABAS-3)*. The Psychological Corporation.

Khowaja, M. K., Hazzard, A. P., & Robins, D. L. (2015). Sociodemographic barriers to early detection of autism: Screening and evaluation using the M-CHAT, M-CHAT-R, and follow-up. *Journal of Autism and Developmental Disorders, 45*(6), 1797–1808.

Lachance, K., Štětinová, K., Rieske, R., & Peer, S. (2021). Repetitive behavior scale for early childhood (RBS-EC): Psychometrics and developmental effects with a community sample. *Child Psychiatry & Human Development*, 1–13.

Lai, M. C., & Baron-Cohen, S. (2015). Identifying the lost generation of adults with autism spectrum conditions. *The Lancet Psychiatry, 2*(11), 1013–1027.

Lavi, A. (2019). *Clinical assessment of pragmatics (CAPs) [Manual]*. Western Psychological Services.

Livingston, L. A., Shah, P., & Happé, F. (2019). Compensatory strategies below the behavioural surface in autism: A qualitative study. *The Lancet Psychiatry, 6*(9), 766–777. https://doi.org/10.1016/s2215-0366(19)30224-x

Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. L. (2012). *Autism diagnostic observation schedule* (2nd ed.). Western Psychological Services.

Lukens, C. T., & Linscheid, T. R. (2008). Development and validation of an inventory to assess mealtime behavior problems in children with autism. *Journal of Autism and Developmental Disorders, 38*(2), 342–352.

Maenner, M. J., Shaw, K. A., Baio, J., Washington, A., Patrick, M., DiRienzo, M., Christensen, D. L., Wiggins, L. D., Pettygrove, S., Andrews, J. G., Lopez, M., Hudson, A., Baroud, T., Schwenk, Y., White, T., Rosenberg, C. R., Lee, L. C., Harrington, R. A., Huston, M., Hewitt, A., Esler, A., Hall-Lande, J., Poynter, J. N., Hallas-Muchow, L., Constantino, J. N., Fitzgerald, R. T., Zahorodny, W., Shenouda, J., Daniels, J. L., Warren, Z., Vehorn, A., Salinas, A., Durkin, M. S., & Dietz, P. M. (2020). Prevalence of Autism Spectrum Disorder among children aged 8 years – autism and developmental disabilities monitoring network, 11 sites, United States, 2016. *Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C.: 2002), 69*(4), 1–12.

Malow, B. A., Crowe, C., Henderson, L., McGrew, S. G., Wang, L., Song, Y., & Stone, W. L. (2009). A sleep

habits questionnaire for children with autism spectrum disorders. *Journal of Child Neurology, 24*(1), 19–24.
Marsh, A., Spagnol, V., Grove, R., & Eapen, V. (2017). Transition to school for children with autism spectrum disorder: A systematic review. *World Journal of Psychiatry, 7*(3), 184.
Matson, J. L., & González, M. L. (2007a). *Autism Spectrum Disorders – Behavior problems – Child version*. Disability Consultants, LLC.
Matson, J. L., & González, M. L. (2007b). *Autism Spectrum Disorders – Comorbidity – Child version*. Disability Consultants, LLC.
Matson, J. L., & González, M. L. (2007c). *Autism Spectrum Disorders – Diagnosis – Child version*. Disability Consultants, LLC.
Matson, J. L., & Kuhn, D. E. (2001). Identifying feeding problems in mentally retarded persons: Development and reliability of the screening tool of feeding problems (STEP). *Research in Developmental Disabilities, 22*(2), 165–172.
Matson, J. L., Boisjoli, J. A., & Wilkins, J. (2007). *Baby and infant screen for children with aUtIsm traits (BISCUIT)*. Disability Consultants, LLC.
Ming, X., Brimacombe, M., Chaaban, J., Zimmerman-Bier, B., & Wagner, G. C. (2008). Autism Spectrum Disorders: Concurrent clinical disorders. *Journal of Child Neurology, 23*(1), 6–13.
Mody, M., & Belliveau, J. W. (2013). Speech and language impairments in autism: Insights from behavior and neuroimaging. *North American Journal of Medicine & Science, 5*(3), 157–161. https://doi.org/10.7156/v5i3p157
Monteiro, M. J., & Stegall, S. (2018). *MIGDAS-2 MIGDAS interview guidelines for diagnosing autism spectrum* (2nd ed.). Western Psychological Services.
Mullen, E. M. (1995). *Mullen scales of early learning* (pp. 58–64). AGS.
Narzisi, A., Muratori, F., Calderoni, S., Fabbro, F., & Urgesi, C. (2013). Neuropsychological profile in high functioning autism spectrum disorders. *Journal of Autism and Developmental Disorders, 43*(8), 1895–1909.
Nazneen, N., Rozga, A., Smith, C. J., Oberleitner, R., Abowd, G. D., & Arriaga, R. I. (2015). A novel system for supporting autism diagnosis using home videos: Iterative development and evaluation of system design. *JMIR mHealth and uHealth, 3*(2), e4393.
Nickel, R. E., & Huang-Storms, L. (2017). Early identification of young children with autism spectrum disorder. *The Indian Journal of Pediatrics, 84*(1), 53–60.
Owens, J. A., Nobile, C., McGuinn, M., & Spirito, A. (2000). The Children's Sleep Habits Questionnaire: Construction and validation of a sleep survey for school-aged children. *Sleep, 23*(8), 1043–1051.
Pearson, N., Charman, T., Happé, F., Bolton, P. F., & McEwen, F. S. (2018). Regression in Autism Spectrum Disorder: Reconciling findings from retrospective and prospective research. *Autism Research, 11*(12), 1602–1620.
Pickett, E., Pullara, O., O'Grady, J., & Gordon, B. (2009). Speech acquisition in older nonverbal individuals with autism: A review of features, methods, and prognosis. *Cognitive and Behavioral Neurology, 22*(1), 1–21. https://doi-org.libpublic3.library.isu.edu/10.1097/WNN.0b013e318190d185
Ratto, A. B., Kenworthy, L., Yerys, B. E., Bascom, J., Wieckowski, A. T., White, S. W., Wallace, G. L., Pugliese, C., Schultz, R. T., Ollendick, T. H., & Scarpa, A. (2018). What about the girls? Sex-based differences in autistic traits and adaptive skills. *Journal of Autism and Developmental Disorders, 48*(5), 1698–1711.
Reynolds, C. R., & Kamphaus, R. W. (2015). *Behavior assessment system for children* (3rd ed.). NCS Pearson, Inc. (BASC–3).
Rivet, T. T., & Matson, J. L. (2011). Review of gender differences in core symptomatology in Autism Spectrum Disorders. *Research in Autism Spectrum Disorders, 5*(3), 957–976.
Robins, D. L., Fein, D., & Barton, M. (2009). The modified checklist for autism in toddlers, revised with followup (M-CHAT-R/F). *Pediatrics, 133*, 37–45.
Roid, G. H. (2003). *Stanford-Binet intelligence scales* (5th ed.). Riverside.
Roid, G. H., Miller, L. J., Pomplun, M., & Koch, C. (2013). *Leiter international performance scale* (3rd ed.). Western Psychological Services.
Rojahn, J., Matson, J. L., Lott, D., Esbensen, A. J., & Smalls, Y. (2001). The Behavior Problems Inventory: An instrument for the assessment of self-injury, stereotyped behavior, and aggression/destruction in individuals with developmental disabilities. *Journal of Autism and Developmental Disorders, 31*(6), 577–588.
Rutter, M., Le Couteur, A., & Lord, C. (2003). *Autism diagnostic interview-revised–WPS* (WPS ed.). Western Psychological Services.
Schopler, E., Bourgondien, M. E., Wellman, G. J., & Love, S. R. (2010). *Childhood autism rating scale* (2nd ed.). Western Psychological Services.
Schreck, K. A. (1998). Preliminary analysis of sleep disorders in children with developmental disorders [Doctoral dissertation, The Ohio State University]. *Dissertation Abstracts International, 58*, 3934.
Schreck, K. A., Mulick, J. A., & Rojahn, J. (2003). Development of the behavioral evaluation of disorders of sleep scale. *Journal of Child and Family Studies, 12*(3), 349–359.
Seiverling, L., Hendy, H. M., & Williams, K. (2011). The Screening Tool of Feeding Problems Applied to Children (STEP-CHILD): Psychometric characteristics and associations with child and parent variables. *Research in Developmental Disabilities, 32*(3), 1122–1129.
Sparrow, S. S., Cicchetti, D. V., & Saulnier, C. A. (2016). *Vineland adaptive behavior scales* (3rd ed.). Pearson.
Sturner, R., Howard, B., Bergmann, P., Morrel, T., Andon, L., Marks, D., Rao, P., & Landa, R. (2016). Autism screening with online decision support by primary care pediatricians aided by M-CHAT/F. *Pediatrics, 138*(3).
Tek, S., & Landa, R. J. (2012). Differences in autism symptoms between minority and non-minority toddlers. *Journal of Autism and Developmental*

Disorders, 42(9), 1967–1973. https://doi.org/10.1007/s10803-012-1445-8

Wechsler, D. (2008). *Wechsler adult intelligence scale–Fourth edition (WAIS-IV)*. NCS Pearson.

Wechsler, D. (2011). *Wechsler abbreviated scale of intelligence–Second edition (WASI-II)*. NCS Pearson.

Wechsler, D. (2012). *Wechsler preschool and primary scale of intelligence* (4th ed.). NCS Pearson.

Wechsler, D. (2014). *Wechsler intelligence scale for children* (5th ed.). NCS Pearson.

Wiig, E. H., Semel, E., & Secord, W. A. (2013). *Clinical evaluation of language fundamentals–Fifth edition (CELF-5)*. NCS Pearson.

Wodka, E. L., Mathy, P., & Kalb, L. (2013). Predictors of phrase and fluent speech in children with autism and severe language delay. *Pediatrics, 131*(4), e1128–e1134. https://doi.org/10.1542/peds.2012-2221

Wolff, J. J., Boyd, B. A., & Elison, J. T. (2016). A quantitative measure of restricted and repetitive behaviors for early childhood. *Journal of Neurodevelopmental Disorders, 8*(27), 1–10. https://doi.org/10.1186/s11689-016-9161-x

Zimmerman, I. L., Steiner, V. G., & Pond, E. (2011). *Preschool language scales–Fifth edition (PLS-5)*. Pearson.

Functional Assessment in Applied Behavior Analysis

5

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Contents

Historical Foundations

B. F. Skinner is among the first authors to use the term *functional analysis* in its contemporary sense.

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Table 5.1 Four dimensions to understand the term "Functional Analysis" in context

Assessment model	#1	#2	#3	#4
Functional analysis of the therapist–client interaction (Ruiz-Sancho et al., 2013)	Yes	No	Yes	NA
Contingency space analysis (Martens et al., 2008)	Yes	No	Yes	Yes
Functional analysis in behavior therapy (Haynes & O'Brien, 2000)	NA	No	NA	NA
Functional analysis of depression (Ferster, 1973)	Yes	No	No	Yes
Functional analysis of self-injury (Iwata et al., 1982/1994a)	Yes	Yes	Yes	Yes
Functional Assessment Screening Tool (Iwata et al., 2013)	Yes	No	No	Yes
Interview-informed synthesized contingency analysis (Slaton et al., 2017)	Yes	Yes	Yes	NA

Notes. 1. Environment–behavior relations, 2. Experimental manipulation, 3. Quantitative terms, 4. Specified operant behavior process. *NA* Not always

> The external variables of which behavior is a function provide for what may be called a causal or functional analysis. We undertake to predict and control the behavior of the individual organism. This is our 'dependent variable'—the effect for which we are to find the cause. Our 'independent variables'—the causes of behavior—are the external conditions of which behavior is a function. Relations between the two—the 'cause-and-effect relationships' in behavior are the laws of a science. A synthesis of these laws expressed in quantitative terms yields a comprehensive picture of the organism as a behaving system. (Skinner, 1953/2014, p. 35)

Skinner's notion of a functional analysis is in sharp contrast with other concepts of functional analysis that abound in psychology.[1] First, the functional analysis is composed of discrete environment–behavior relations. Second, the functional relation is assessed by deliberate manipulation of the independent variable. Therefore, a functional analysis should have the central elements of an experiment. Third, the relation is expressed in quantitative terms. Finally, the functional relation may be synthesized or subsumed into *laws of science* (cf., behavior processes such as discrimination or reinforcement). As the examples in Table 5.1 indicate, considering these four dimensions can orient the reader in the vast literature that uses the term *functional analysis*. For example, Charles Ferster's, *Functional Analysis of Depression* (1973) involved behavior–environment relations and behavior principles, but lacked quantitative terms and experimental manipulation. This form of exploratory functional analysis is sometimes referred to as *conceptual analysis* (Table 5.1). In the current manuscript, we will be primarily focused on functional analyses that retain these four elements as they are applied to behavior excesses. The term functional analysis is typically used to refer to strategies featuring experimental control and direct behavioral observation, whereas the term *functional assessment* may include nonexperimental approaches. Due to their practical relevance, we will also discuss nonexperimental functional assessments based on informant methods (questionnaires and interviews) and descriptive analyses.

The Functions of Problem Behavior

Theodore Ayllon and Jack Michael in *The Psychiatric Nurse as a Behavioral Engineer* (1959) provide one of the first demonstrations of problem behavior being "turned on and off" by the systematic presentation and withdrawal of naturalistic events (e.g., social attention). Analyses such as Ayllon's and Michael's

[1]Haynes and O'Brien (1990) comment on a number of such notions.

indicated that it may be possible to evaluate the social reinforcers maintaining problem behavior in naturalistic settings. Additional demonstrations in the 1960s and 1970s expanded this analysis to problem behaviors maintained by social negative reinforcement and automatic (sensory) reinforcement. For example, Carr et al. (1976) systematically presented and withdrew task demands to show that self-injury may be maintained by escape. These findings did not coalesce into a cogent model of assessment until the early 1980s with Brian Iwata's functional analysis procedure (Iwata et al., 1982/1994a), which provides the basis to most functional analysis protocols that continue to be used in clinical practice today. For easy reference, we will refer to this model as the *standard model* of functional analysis. The standard model gradually fueled a shift in approach in the assessment and treatment of problem behavior of individuals with intellectual and developmental disability, from the topography-based behavior modification of the 1960s and 1970s toward function-driven interventions.

The Standard Model of Functional Analysis

The standard model integrated various environment–behavior relations as distinct three-term contingencies. The approach was subsequently reformulated to incorporate motivating operations as part of the assessment (i.e., variables that momentarily alter the reinforcing effects of consequent events). Table 5.2 presents a summary of the antecedent–behavior and behavior–consequence event relations included in the functional analysis model. The most common conditions used in the standard model are described below. A simplified functional analysis protocol is included in Appendix 1.

Alone/Ignore/No Interaction During the *alone* condition of a functional analysis, the client is placed in an unstimulating environment with no access to other people or preferred items. It is assumed that problem behavior maintained by its sensory feedback (automatic reinforcement) may be more likely to occur in the absence of any potentially interfering stimuli. Because some participants could not be left unsupervised due to potential health risks (i.e., self-injurious behavior), the alone condition described by Iwata et al. (1982/1994a) is often modified to an ignore or no/interaction condition. The practitioner stays in the room with the participant but otherwise does not interact with him or her. Specifically, the practitioner does not make eye contact and stays in an inconspicuous location (e.g., to the side or back of the participant) at some distance from the participant. Unless previously specified termination criteria are met, the practitioner ignores all participant behavior.

Attention The *attention* condition is the test condition for social positive reinforcement. During this condition, the practitioner states that she needs to finish her work (or equivalent statement to that effect). Whenever the target behavior occurs, the practitioner delivers a brief statement

Table 5.2 Environment–behavior relations in the standard functional analysis

Condition	S^D	MO	Sr+
Alone	N/A	Barren environment	Sensory stimuli
Attention	Presence of another person	Deprivation from attention	Access to attention
Tangible	Presence of another person	No access to tangibles	Access to tangibles and attention
Play	N/A	Noncontingent toys and attention	N/A
Demand	Presence of another person	Presentation of demands	Escape from demands

Notes. S^D discriminative stimulus, *N/A* Not applicable, *MO* Motivating operation, *Sr+* reinforcer expressing concern or reprimand (e.g., "Are you alright?" "You don't have to do that") followed by brief physical contact. Attention statements can be made consistent with those reported by caregivers during a preliminary interview. If problem behavior continues while attention is being delivered, the interaction may also continue. Thus, social interaction is contingent only on the occurrence of the target behavior and other direct attempts by the participants to engage are ignored. Some practitioners also provide access to two moderately preferred toys during the attention condition (McCord & Neef, 2005).

Tangible During the *tangible* condition, the researcher withdraws a high-preference item that would have been previously available. Whenever the target behavior occurs, the researcher delivers the high-preference item to the participant along with a brief statement (e.g., "OK, you can have your iPad"). Attention statements may be consistent with those observed or reported to occur in the natural environment. The interaction with the item can take a few seconds until the items is withdrawn again. The delivery of the item is contingent only on the occurrence of the target behavior and other direct attempts by the participants to engage are ignored.

Demand During the *demand* condition, the therapist presents demands for activities that have been previously screened during an interview. Practitioners often use academic-type tasks and demands presented continuously throughout the session (or other activities that reportedly precede problem behavior). The therapist may use a three-step prompting sequence comprised of verbal instruction, followed by modeling, and a full physical prompt with brief interprompt interval. Aside from the task materials, no other stimuli are available to the participants during this condition. When the student engages in the target behavior, the therapist withdraws the task materials and ceases presenting demands for a brief time. The researcher provides unenthusiastic verbal praise (e.g., "well done") when the participant complies with or completes the task and resumes task demands immediately after the delivery of praise.

Play During the *play* or control condition of functional analysis, participants have noncontingent access to high-preference toys and activities. The researcher delivers noncontingent attention at regular intervals, unless the scheduled delivery of attention overlaps with the occurrence of the target behavior, in which case the therapist waits for the behavior to stop and delivers attention after a brief delay. Attention statements are free of demands (e.g., "Wow, that is so cool!"). The therapist usually interacts with the participant for a few seconds and delivers brief physical contact (e.g., pat on the back). All appropriate attempts to engage with the researcher lead to attention and all instances of the target behavior are ignored. There are no demands or attention contingent on the problem behavior. Also, high-demand items are available that potentially interfere with automatically maintained behavior. Thus, problem behavior maintained by any of the test contingencies in a standard functional analysis is expected to be low.

Notable variations and refinements of the standard procedure sketched above can be encountered in practice and in the literature, which may impact the outcome of the assessment. For example, Hammond et al. (2013) reported that a functional analysis with a fixed condition sequence (alone–attention–play–demand) was more likely to produce differentiated results than a random-order functional analysis. Thus, minor procedural changes may alter the assessment findings. Therefore, it is critical for the practitioner to attain an intimate understanding of the functional role of the various elements in a functional analysis, such as the establishing effects of certain condition sequences in Hammond et al. (e.g., in an alone–attention sequence, attention deprivation during the former may lead to more behavior during the latter). Reviews of common procedural variations in a functional analysis are available in Beavers et al.

(2013), Lydon et al. (2012), and Schlichenmeyer et al. (2013) (see also Appendix 1).

Approaches to Assessment Derived from the Standard Model

A graphical representation of the variations on the standard model discussed below can be found in Fig. 5.1.

Assessment Time Variations A potential challenge to conducting a functional analysis is the time investment; some assessments require over 10 h of observations. It has been proposed that by reducing the functional analysis to a single 5 min probe session per condition, it may be possible to identify the function of problem behavior on some occasions. A case series of 79 *brief functional analyses* by Derby et al. (1992) indicated that problem behavior occurred during the assessment in 63% of clients, and a function could be identified in 74% of those that did display problem behavior. Thus, a function could be identified in about half of all cases. However, subsequent analysis has shown poor correspondence between the function identified across brief and standard assessments (about 25% according to a case series of 19 participants by Muething et al., 2017). A similar variation

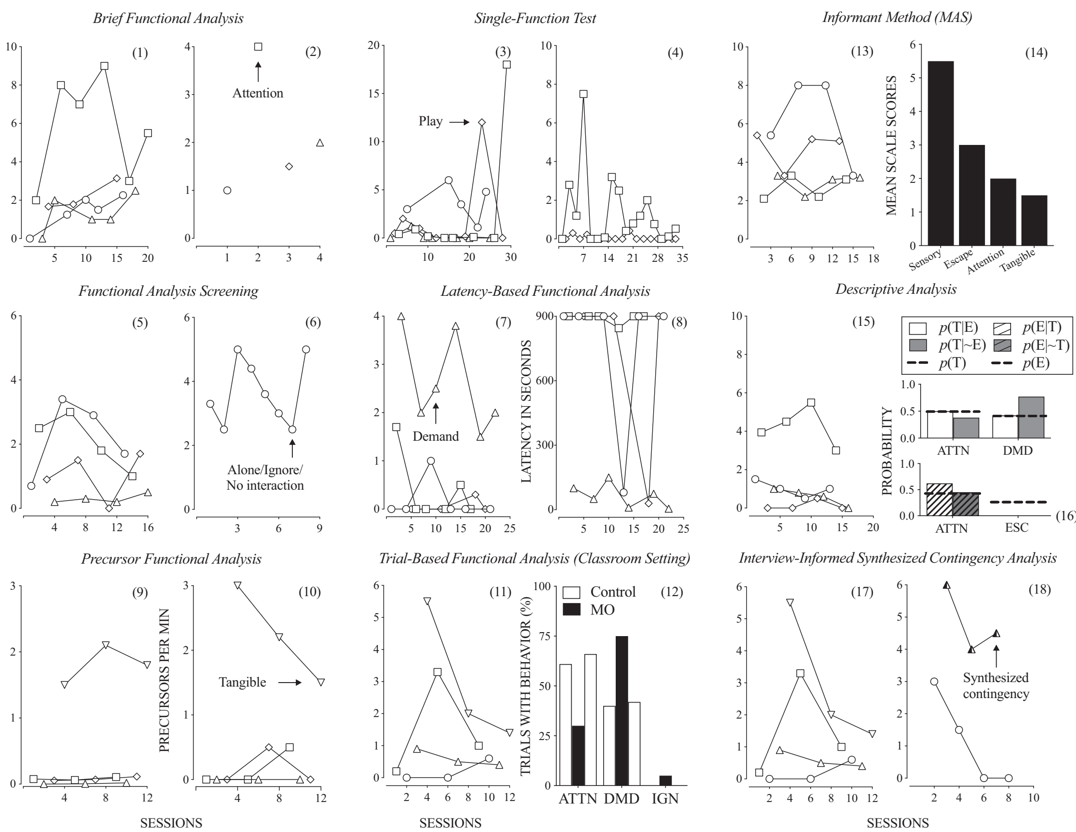

Fig. 5.1 Graphical examples of common functional assessment models. *Note*. Corresponding standard functional analysis to the left of each pair of graphs, *y* axes are scaled in responses per minute unless otherwise indicated. ATTN Attention, ESC Escape, DMD Demand, IGN Ignore, MAS Motivation Assessment Scale. Descriptive analysis notation in Table 5.4. All graphs portray hypothetical data

intended to address time constrains is the pairwise or single-function functional analysis, which uses information obtained from interviews and casual observations to contrast a single test function with the control play condition (Iwata et al., 1994b). A variation of this approach has been developed to screen for automatic reinforcement. The approach assumes that the stable occurrence of problem behavior over a series of alone sessions is sufficient to verify an automatic function in the absence of any other control or test conditions (Querim et al., 2013).

Latency-Based Functional Analysis Due to the negative correlation between behavior rate and latency, some authors have suggested that it may be possible to assess the function of problem behavior using latency as a behavior dimension (Neidert et al., 2013; Thomason-Sassi et al., 2011). This approach typically reports a single latency value per session, thereby optimizing assessment duration and minimizing the number of occurrences of problem behavior needed. Thus, latency-based functional analysis may be particularly appropriate for severe problem behaviors that could pose risks to the client if they were to occur at high rates during the assessment.

Precursor Functional Analysis Severe problem behaviors are often part of complex hierarchical response classes whereby relatively milder forms of problem behavior precede relatively more severe behaviors (e.g., Harding et al., 2001). It has been demonstrated that specific *precursors* can systematically precede the occurrence of severe problem behavior and therefore could be used as the target of assessment and treatment, in the assumption that they serve the same operant function as problem behavior (Fritz et al., 2013). Because the reinforcement of a precursor tends to eliminate the occurrence of more severe behavior, precursor functional analysis is safer than assessments that require the repeated occurrence of problem behavior. This benefit is partially offset by the procedures needed to identify the precursors, which often require the direct observation of precursor–behavior sequences. Several procedures have been proposed to identify hierarchically related behaviors and precursors including caregiver report, extinction analyses, conditional probability analyses, and latency analyses (see Heath Jr & Smith, 2019 for a brief review). While precursor topography may be very diverse across behaviors and individuals, unintelligible vocalizations account for one third of precursors across problem behavior topographies and operant functions according to one report, possibly due to the low effort involved (Fahmie & Iwata, 2011). The analyses available indicate that the precursor functional analysis can predict the outcome of a standard functional analysis in over 90% of the assessments (Borlase et al., 2017; Borrero & Borrero, 2008; Fritz et al., 2013; Herscovitch et al., 2009; Smith & Churchill, 2002). However, a precursor functional analysis may not be adequate in some clinical scenarios. Specifically, the continuous availability of the automatic reinforcer is unlikely to shape hierarchical behavior–behavior relations. Therefore, precursors do not usually precede behavior maintained by automatic reinforcement.

Trial-Based Functional Analysis for Problem Behavior Evoked by Transitions Problem behavior evoked by activity transition can be common in individuals with autism spectrum disorder (Lequia et al., 2015). However, the standard model does not properly sample contingencies present in a transition. These contingencies can involve the termination of an activity, activity initiation, and location change. Further refinements of this environmental factors are possible when considering the reinforcing (or aversive) effects of the activity to be terminated and the activity that the individual is transitioning into. McCord et al. (2001) proposed a trial-based approach in which various key elements of naturally occurring transitions are presented systematically. The percentage of trials with problem behavior can then be used to identify the likely function of the behavior (see also Wilder et al., 2006).

Trial-Based Functional Analysis in Ecological Settings The ecological validity of the standard model is often challenged by problem behavior occurring in the classroom or other naturalistic setting where there may not be enough material or human resources to conduct a full functional analysis. The trial-based functional analysis has been proposed as a model that is easily adaptable to the classroom dynamics and may be delivered by teachers (Griffith et al., 2019). The procedure involves presenting and then removing the motivating operation of the test conditions in a functional analysis on several occasions throughout the school day to evaluate behavior function (Bloom et al., 2011). For example, a teacher could evaluate whether peer-directed aggression is caused by escape from demands by presenting demands for a brief period (test trial), then withdrawing the demand over the same time (control trial). Over repeated trials, it is possible to compute the percentage of times where problem behavior was present during test trials relative to control trials. The trial-based functional analysis does not always correspond with the outcome of a standard functional analysis. The level of correspondence with a standard functional analysis has been modest (~60%, according to some reports; see, for example, Rispoli et al., 2014). However, the naturalistic setting of the trial-based functional analysis may not be easily reproduced in a standard functional analysis, which makes using it as a gold standard problematic.

Interview-Informed Synthesized Contingency Analysis (IISCA) The IISCA (sometimes referred to as *practical functional analysis*) was developed in order to address some of the barriers to performing a functional analysis such as limited time and resources (Coffey et al., 2020). Similarly, in recent years some researchers have raised concerns pertaining to the ecological validity of isolated social contingencies in the standard model. Specifically, the standard model is contrasted with the seemingly high prevalence of combined social contingencies in the natural environment (e.g., escape from demands followed by access to preferred tangibles). The proponents of IISCA suggest that deconstructing these contingencies as part of the functional analysis process may result in undifferentiated results that often go unreported, thereby concealing the practical utility of the standard model (Slaton et al., 2017). While the validity of these concerns continues to be an area of active research (e.g., Fisher et al., 2016), the IISCA model responds to these challenges by using a single test condition that incorporates all elements of naturalistic social contingencies (i.e., synthesized contingency) as they occur in the natural environment according to interviews and casual observations. The single test condition is compared to a matched control, reducing the time and resource burden of the functional analysis. The proponents of the IISCA model admit that elements of synthesized contingencies may not have a functional role (e.g., escaping demands and not accessing tangibles may be the key contingency), which could lead to redundant treatment components (e.g., mand training for tangibles). The utility of the IISCA model in predicting effective treatment remains to be an area of active research (Tiger & Effertz, 2021).

The functional analysis method used, whether the standard method or one of its variations, will be determined by a range of factors, including the environment in which the assessment is taking place (e.g., school or residential), the availability of time and resources, the frequency and severity of the behavior, among others. We summarize some of this information in the decision-making model presented in Fig. 5.2. This model is presented for clarification purposes only. This model can be used in conjunction with the practical information summarized in Table 5.3.

Informant Methods

Nonexperimental approaches to functional analysis have often been classified as *anecdotal* and *descriptive*. Anecdotal or indirect methods typi-

Selection of Functional Analysis Variations in Applied Settings

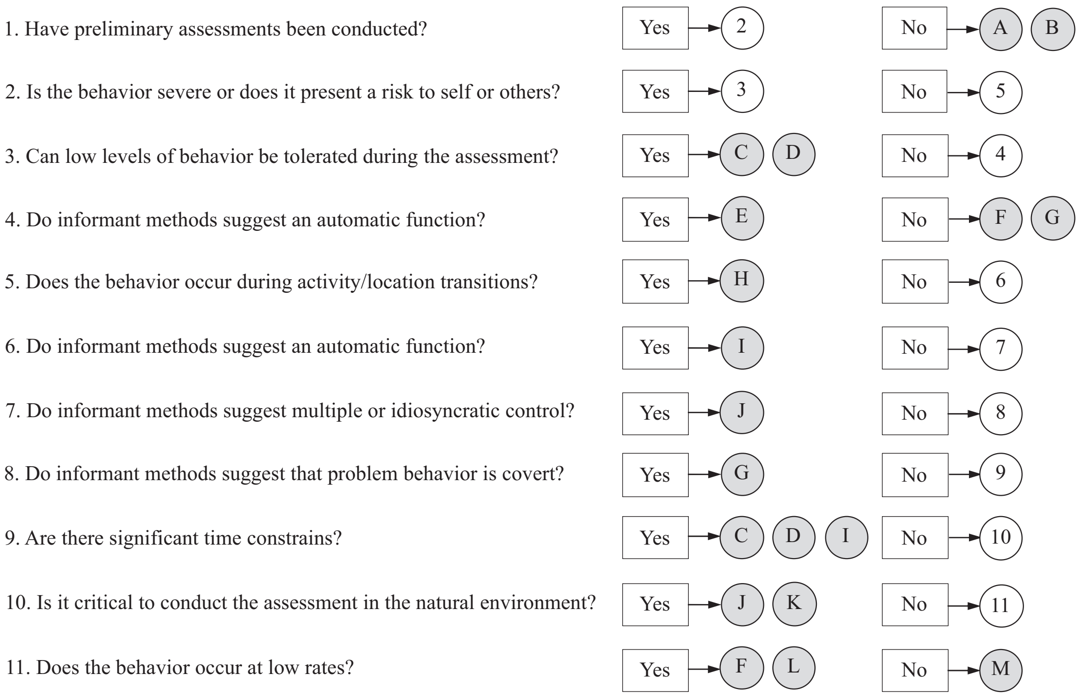

Fig. 5.2 Selection of functional analysis variations in applied settings. *Notes*. A. Request medical referral if appropriate; B. Validated informant method with multiple informants (e.g., Iwata et al., 2013); C. Brief functional analysis (Derby et al., 1992; Vollmer et al., 1995); D. Latency functional analysis (Thomason-Sassi et al., 2011); E. Proceed to treatment or conduct further automatic-specific assessments; F. Precursor functional analysis (Fritz et al., 2013); G. Reinforcer assessment (Grace et al., 1996); H. Trial-based functional analysis during transitions (McCord et al., 2001); I. Pairwise or single-function test (Iwata et al., 1994b)/Functional analysis screening (Querim et al., 2013); J. Interview-informed synthesized contingency analysis (Hanley et al., 2014); K. Trial-based functional analysis for natural settings (Bloom et al., 2013); L. Extended-duration functional analysis (Tarbox et al., 2004); M. Standard functional analysis (Iwata et al., 1982/1994a)

cally involve the use of questionnaires and interviews. Some of these questionnaires have been the subject of reliability and validity studies. The *Motivation Assessment Scale* (MAS; Durand & Crimmins, 1988) was the first of such instruments and possibly the one that has produced the most research over the years (see Table 5.4 for a summary of this literature). The studies indicate that, while basic psychometric properties such as internal consistency and test–retest reliability are within the range of usable values, raters agreed on the likely function of problem behavior only in about 50% of cases (Table 5.4). Moreover, while over 1000 individuals have been assessed as part of this literature over the last 40 years, the MAS has been followed by a functional analysis only in about 2% of these assessments. These few datasets indicate that in 65% of cases, the outcome suggested by the MAS coincided with the outcome of the functional analysis. The Functional Analysis Screening Tool (FAST) has been the subject of a large-*n* criterion validity analysis producing an overall function correspondence of 65% (44 of 69) (Iwata et al., 2013), which is surprisingly consistent with the MAS literature.

Table 5.3 Key practical dimensions of common functional assessment models

	SFA	AA	DA	BFA	IISCA	LFA	PFA	TBFA	SFT
Adequate for automatic reinforcement	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Adequate for multiply controlled behavior	Yes	Yes	Yes	Yes	Yes	Yes	NA	NA	No
Amenable to idiosyncratic MOs	No	No	Yes	No	Yes	No	No	Yes	No
Assessment time	High	Low	High	Low	Low	Low	High	Low	Low
Behavior rate-related risks	High	Low	Low	Low	Mid	Low	Low	Mid	Mid
Convergent validity with SFA	–	Mid	Low	Mid	Mid	High	High	Mid	Mid
Risk of iatrogenic/false-positive functions	Low	High	High	Low	Mid	Low	Low	Mid	Mid
Ecological validity	Mid	Low	High	Mid	High	Mid	Mid	High	Mid
Rate of undifferentiated results	Low	Mid	High	High	Low	Low	Low	Mid	High
Treatment predictive validity	High	Mid	Low	Mid	Mid	High	High	High	Mid

Notes. *AA* Anecdotal assessments, *BFA* Brief functional analysis, *DA* Descriptive analysis, *IISCA* Interview-informed synthesized contingency analysis, *LFA* Latency-based functional analysis, *MO* Motivating operation, *NA* Not always, *PFA* Precursor functional analysis, *SFA* Standard functional analysis, *TBFA* Trial-based functional analysis, *SFT* Single-function test/Functional analysis screening

Instruments like the MAS have also proved to be flimsy in their conceptual underpinning. For example, of the eight factor analyses that have been conducted for the MAS, only two have identified the four domains of the scale (Bihm et al., 1991: Singh et al., 1993) with any of the individual domains being identified only about half of the time (see Table 5.4 for details). An analysis by Smith et al. (2012) indicated that the MAS may be particularly indicative of behavior function only for assessments with high levels of inter-rater agreement. Specifically, they identified seven cases of problem behavior for which at least four of five MAS respondents had agreed on the function of the behavior. They then proceeded to conduct full functional analyses and found function correspondence in six out of the seven assessments.

Overall, this literature suggests that anecdotal assessments are helpful in gathering interview data systematically and can help to design more targeted experimental assessments, including single-function tests, screening functional analysis, and IISCA assessments (see Fig. 5.2 for details). It is worth mentioning that some of these tools have been made available in languages other than English. For example, the MAS and the FAST are available in Spanish (Durand & Crimmins, 2011; Iwata et al., 2020).

Descriptive Analyses

Descriptive analyses comprise observations of problem behavior in its natural environment and in the absence of direct independent variable manipulations. Common forms of descriptive assessment include scatter plots, ABC data, and event recording. In a scatterplot, the observer records the occurrence of problem behavior often using ordinal labels (e.g., no behavior, some behavior, frequent behavior) over relatively long intervals (e.g., 1-h intervals). This assessment can provide an indication of the activities that are correlated with problem behavior, assuming that these change over time as it may be the case in the school setting. The ABC recording involves an observer writing down a narrative summary of the events that occurred before and after problem behavior and usually completed by caregivers of other individuals that spend time with the participant. Sometimes it is also possible to conduct ABC recordings using observation schedules that include various antecedent and consequent alternatives for the observer to check.

Descriptive analyses that use continuous event recording require operational definitions of the target events and conditional probability analyses.

Table 5.4 Quantitative properties of the motivation assessment scale in the literature (Period, 1988–2022)

			Reliability				Validity		
	n	Topography	Cronbach alpha	Function agreement (%)	Interrater	Test–retest	Construct	Convergent	Criterion % (*n*)
Bihm et al. (1991)	118	Mixed	–	–	–	–	4 (Al, E, A, T)	–	–
Duker and Sigafoos (1998)	86	Mixed	0.68–0.87	66.7	−0.19–0.87	–	4 (E, T)	–	–
Durand and Crimmins (1988)	50	Self-injury	–	–	0.80–0.95	0.82–0.99	–	–	100.0 (8)
Freeman et al. (2007)	91	Mixed	0.67–0.87	–	–	–	–	0.66–0.76	–
Joosten and Bundy (2008)	67	Stereotypic	–	–	–	–	2 (Al)	–	–
Kearney (1994)	42	Mixed	–	–	0.35–0.82	–	–	–	–
Kearney et al. (2006)	315	Mixed	0.71–0.85	–	–	–	3 (E, A, T)	–	–
Koritsas and Iacono (2013)	70	Mixed	0.88–0.94	58.3	0.77–0.89	–	1 (A)	0.66–0.78	–
Ollington (2016)	2	Sameness	–	–	–	–	–	–	50.0 (2)
Paclawskyj et al. (2001)	13	Mixed	–	–	–	–	–	0.51–0.86	38.5 (13)
Shogren and Rojahn (2003)	31	Mixed	0.80–0.96	–	0.35–0.73	0.71–0.88	–	0.73–0.89	–
Sigafoos et al. (1994)	18	Aggressive	–	44.4	−0.67–0.72	–	–	–	–
Singh et al. (1993), Study 1	60	Self-injury	–	–	–	–	4 (Al, E, A, T)	–	–
Singh et al. (1993), Study 2	96	Self-injury	–	–	–	–	3 (Al)	–	–
Spreat and Connelly (1996)	47	Self-injury	0.68–0.84	70.0	0.31–0.57	–	–	–	–
Virues-Ortega et al. (2011)	80	Mixed	0.65–0.82	73.9	0.37–0.61	–	3 (Al, A, T)	–	–
Wasano et al. (2009)	3	Pica	–	–	–	–	–	–	100.0 (3)
Zarcone et al. (1991)	55	Self-injury	–	29.1	~0.41	–	–	–	–
Overall range or mean			0.65–0.94	57.1	−0.67–0.95	0.71–0.99		0.51–0.89	65.4 (26)

Notes. A Attention, *Al* Alone, *E* Escape, *T* Tangible. Inter-rater reliability and convergent validity reported as scale scores correlation coefficients. All convergent validity tests compared the MAS with Questions About Behavior Function. All construct validity tests conducted by way of factor analysis. Criterion validity tests involved comparing the outcome of the MAS with the outcome of a functional analysis. Smith et al. (2012) could not be aggregated in this table

High conditional probabilities of antecedent–behavior and behavior–consequent sequences are then taken as an indication of behavior function. While evaluating conditional probabilities it is important to also ensure that the unconditional probability of the target events and unrelated conditional probabilities are relatively low (for a mobile device application to record and compute conditional probabilities see Virues-Ortega, 2019). Table 5.5 presents a summary of common probability calculations for descriptive analyses. Logical rules, as the ones specified in Formula (5.1) can then be used to identify target behavior (T)–event (E) relations that would be indicative of behavior function.

$$\left[p\left(\mathrm{T}|\mathrm{E}\right) > p\left(\mathrm{T}|\sim\mathrm{E}\right) \text{ and } p\left(\mathrm{T}|\mathrm{E}\right) > p\left(\mathrm{T}\right)\right], \text{ and } \left[p\left(\mathrm{E}|\mathrm{T}\right) > p\left(\mathrm{E}|\sim\mathrm{T}\right); p\left(\mathrm{E}|\mathrm{T}\right) > p\left(\mathrm{E}\right)\right]. \tag{5.1}$$

Even though they have the apparent advantage of using systematic observations and quantitative analyses (e.g., ABC recording, scatter plots, interval recording, conditional probabilities), the literature suggests that descriptive analyses are not valid means of ascertaining behavior function. In a review of the literature, Wightman et al. (2014) reported that, among cases reporting both descriptive and functional analyses, only 11% predicted the results of a functional analysis ($n = 27$). If we were to make the assumption that common outcomes of a functional analysis (i.e., multiply controlled, attention-maintained, escape-maintained, automatically maintained, tangible-maintained, idiosyncratic functions, undifferentiated assessment) are evenly distributed, it could be argued that descriptive analyses perform at chance levels when compared with a standard functional analysis.

Some of the obvious sources of bias of a descriptive analysis include the tendency of severe problem behavior to result in attention from caregivers and others (whether attention is or not the maintaining event). Also, problem behaviors, as they occur in naturalistic settings, may be maintained by complex and unpredictably intermittent schedules. Therefore, merely computing conditional probabilities from contiguous behavior-consequent events under a thin schedule may lead to a much-distorted picture of behavior function.

As discussed above, there is still a role for descriptive analyses within the toolbox of a behavior analyst. First, a descriptive analysis can provide important insights on the real-life scenarios leading to problem behavior. This information could be incorporated in subsequent assessments. Moreover, descriptive analyses allow the practitioner to access contexts that may not be suitable for a functional analysis (e.g., home, community, classroom). Ideally, the details obtained in a descriptive analysis can inform a subsequent (potentially more targeted) functional analysis. In clinical settings where there might be limited time, questionnaires, interviews, anecdotal observations, and descriptive analyses are often used as the basis to establish treatment strategies. This approach, which could produce time-savings in the short term, may result in a delay of an effective intervention in some cases. However, there is a lack of cost–benefit analyses in the literature. On the opposite side of the argument, a few studies indicate that abbreviated assessments including informant-based

Table 5.5 Elements in a conditional probability analysis

Probability type	Formula
Conditional probability of the target (T) given the antecedent or consequent event (E)	p(T|E) = 10-s time window with E that also contain T divided by 10-s time window with E
Conditional probability of T given the absence of E	p(T| ~ E) = 10-s time window with T without E divided by 10-s time window with T
Unconditional probability of T	p(T) = 10-s time window with T divided by Total 10-s time window
Conditional probability of E given T	p(E|T) = 10-s time window with T that also contain E divided by 10-s time window with T
Conditional probability of the E given the absence of T	p(E| ~ T) = 10-s time window with E without T. divided by 10-s time window with E
Unconditional probability of E	p(E) = 10-s time window with E divided by Total 10-s time window

functional assessment and trial-based functional analysis can lead to treatment gains significantly above interventions conducted in the absence of any functional assessment (Bloom et al., 2013; Hurl et al., 2016).

Topography-Specific Functional Assessments

Variations on the functional analysis process specific to feeding, sleep, and verbal behavior are described briefly below but will be detailed further in other chapters.

Pediatric Feeding Disorders Functional analyses have been applied within mealtime contexts to examine the function of food refusal and inappropriate mealtime behaviors (e.g., turning head from the food, pushing food away; Piazza et al., 2003). Variations of the functional analysis process may include selecting only the conditions hypothesized to be relevant based on caregiver interview and initial mealtime observations (Bachmeyer et al., 2009; Kirkwood et al., 2021a), and keeping the motivating operation (i.e., food presentations) consistent across all evaluated conditions (Bachmeyer et al., 2009; Kirkwood et al., 2021a; Piazza et al., 2003). Some research has evaluated demands only in the escape condition (Najdowski et al., 2008), but this method may tend to underestimate functions other than escape (e.g., attention that functions as a reinforcer only when feeding demands are present) (Bachmeyer et al., 2019). Pairwise functional analyses can be applied where each test condition is alternated with a control condition (e.g., attention vs. control, escape vs. control; Bachmeyer et al., 2009; Kirkwood et al., 2021a, b). It is worth noting that a body of pediatric feeding research consistently identifies negative reinforcement (escape from food or drink) as the most common function of food refusal. Thus, functional analyses may be implemented less frequently in this area (Saini et al., 2019a, b). Alternatively, further feeding-related assessments may take a structural analysis format, where relevant antecedents (volume, texture, spoon position) are manipulated while consequences (escape, or escape extinction procedures) remain constant (Kadey et al., 2013; Patel et al., 2002; Rivas et al., 2010).

Sleep Functional analysis procedures have been applied to evaluate various sleep-disrupting behaviors in children with autism, such as night awakenings, delayed sleep onset, unwanted co-sleeping attempts, or excessive daytime sleeping (Friedman & Luiselli, 2008). The assessment process may involve a specific structured interview (Hanley, 2005), informant questionnaires (Friedman & Luiselli, 2008), sleep diaries and ABC checklists, infra-red nighttime video, and sensors (Hanley, 2005; Jin et al., 2013; McLay et al., 2017, 2019a, b). Using these various approaches, researchers have identified varied functions, including attention (consoling, parent lying with child, breastfeeding), tangible (e.g., pacifier, book, bottle, breastfeeding (McLay et al., 2017)), and automatic (self-stimulatory behaviors interfering with sleep (McLay et al., 2019a, b). While an experimental functional analysis is not feasible for the sleep context, successful interventions have been developed based on anecdotal functional analysis results.

Verbal Behavior Functional assessment methodology has allowed evaluation of the variables that evoke and maintain verbal behavior, to inform verbal behavior training, and to evaluate effectiveness of prior instruction, and to conduct research on language development (Plavnick & Normand, 2013). The conditions in a functional analysis of verbal behavior are informed by the antecedents and consequences of the verbal operants including mands, tacts, intraverbals, and echoics (Lerman et al., 2005; Normand et al., 2008). For example, a mand test condition involves the restriction of an object as the antecedent and the return of the object as the consequence following the child's mand, whereas a tact test condition involves the object present and praise as the only consequence for the correct tact.

Research has shown differing verbal responses across conditions (Lerman et al., 2005; Normand et al., 2008). In looking specifically at the function of mands, Plavnick and Ferreri (2011) conducted a functional analysis for four children with autism and severe language impairment, who communicated with gestures. Results of the functional analysis showed that mands functioned as requests for attention for one child, and for requests for a tangible item for three children. During intervention, the researchers implemented video modelling with sequences that were function- or nonfunction based. Children repeatedly acquired mands during the function-based intervention that generalized to new settings and situations. As children are taught verbal responses under specific teaching conditions in therapy, a functional analysis of verbal behavior can identify whether verbal operants occur outside of those specific conditions, or whether the operant is multiply controlled, which may lead to the identification of undesirable sources of stimulus control (Plavnick & Normand, 2013).

Data Analysis and Clinical Decision-Making

Visual analysis is the most commonly used strategy to evaluate the outcome of a functional analysis. While visual analysis is used throughout behavior analysis, there are a few key aspects of the visual analysis process that are specific of functional analysis (for a detailed discussion of visual analysis, see Virues-Ortega et al., 2022). First, visual analysis is a continuous process requiring data processing and graphing in near real time so that the practitioner can implement changes or finalize the assessment when needed. Second, functional analyses frequently use a multielement design, which brings different considerations to the visual analysis process. Specifically, a multielement design demands rapid discrimination and control within the duration of a few sessions. For example, the alone condition is expected to result in very few occurrences of behaviors maintained by social contingencies, maybe showing decreasing responding over a few session series showing an extinction effect. Lack of differentiated responding can lead to important decisions, such as switching the assessment design, introducing procedural changes to facilitate stimulus control (e.g., making test sessions more distinctive), or introducing relevant stimuli in order to better emulate critical stimuli in the natural environment. Therefore, a functional analysis is a dynamic process that does not have a prescribed duration. However, most assessments are expected to demonstrate a degree of differentiation over the course of three complete condition series.

Structural criteria and statistical analyses have also been proposed to evaluate the outcome of a functional analysis. These procedures are used primarily in research contexts where interrater reliability of the functional analysis may be seen as more important. However, some studies have highlighted the often-low interrater reliability of visual analysis more generally (see, for example, Ninci et al., 2015). Therefore, using structural criteria for a functional analysis may also be important for staff training purposes or when supervising several staff members involved with a particular assessment. Hagopian et al. (1997) proposed a set of criteria (subsequently updated by Cox & Virues-Ortega, 2016) to establish the outcome of a functional analysis. In addition, Virues-Ortega et al. (2022) have proposed structural criteria to identify suboutcomes within automatic reinforcement.

Statistical analyses have been used only rarely for analyzing multielement data. However, it is possible that statistical analysis may be used more widely in research contexts in the future as they seem to have some distinct advantages: (1) they can provide a quantitative index of functional analysis differentiation, (2) they can facilitate the aggregation of datasets for systematic reviews and meta-analyses, and (3) they provide common metrics with the mainstream treatment outcome literature, which could accelerate the uptake of behavior-analytic research by social, health, and education policy makers. The interested reader is referred to Virues-Ortega et al. (2022) for a case study of hierarchical linear modeling in a functional analysis, and Weaver and Lloyd (2018) for the use of randomization tests with multielement designs.

Treatment Informed by Functional Assessment

Treatments informed by functional analyses generally involve two key principles. First, reinforcement that maintains the problem behavior is withheld (operant extinction). Second, consequences are precisely applied to strengthen an alternative behavior that is important to the individual (reinforcement). As part of this process, antecedent variables may also be manipulated. More complex topographies or multiple functions necessitate increased complexity of the intervention, usually including multiple components.

One of the most widely used procedures, differential reinforcement, involves providing the functional reinforcers upon on appropriate alternative behavior, while the problem behavior undergoes extinction. Commonly, differential reinforcement is applied within functional communication training, whereby the alternative behavior taught is a communicative response (Herzinger & Campbell, 2007). In an example for escape-maintained behavior, an individual is provided with escape upon a functional communication response (e.g., "Break please"). Upon the problem behavior, escape extinction involves preventing the individual from escaping the instruction (e.g., through prompting or physical guidance). More current applications of functional communication training include focus on schedule thinning, or shifting from tolerance of denial to compliance with instructions, while considering multiple functions (Hanley et al., 2014; Jessel et al., 2018).

Noncontingent reinforcement is another common function-based treatment whereby the functional reinforcers are delivered on a fixed or variable response-independent schedule. Providing noncontingent reinforcement is presumed to affect the motivating operations for engaging in the behavior and therefore reduce the occurrence of the target behavior. Procedures may be applied concurrent with extinction for the problem behavior. Noncontingent reinforcement has been demonstrated as effective in meta-analyses (Richman et al., 2015) and consecutive controlled case series (Phillips et al., 2017).

Results of quantitative syntheses or meta-analyses consistently report the effectiveness of function-based interventions for individuals with autism, specifically including noncontingent reinforcement (Richman et al., 2015), functional communication training (Greer et al., 2016), and differential reinforcement procedures (Weston et al., 2018). Evidence remains high in larger *n* studies and controlled trials for reducing specific behaviors such as eloping (Scheithauer et al., 2021) or interventions applied in outpatient clinics (Jessel et al., 2018). Literature consistently highlights the effectiveness of function-based treatments in reducing severe problem behavior, especially when compared to interventions not preceded by functional analysis (Campbell, 2003; Chezan et al., 2017; Heyvaert et al., 2014; Hurl et al., 2016).

When choosing an intervention, function may be the primary factor during intervention design, but practitioners also need to balance various clinical aspects of the environment in which the intervention will take place (Spencer et al., 2012). Practical considerations include the skills of behavior change agents and resources available to ensure adequate treatment integrity (e.g., therapeutic environments, see Van Houten et al., 1988). A lack of treatment integrity risks ineffective or negative behavior change (e.g., Gerhardt et al., 2004). Along with the skills and resources, it is also important that we capture naturally occurring reinforcers and schedules of reinforcement when planning an intervention.

Likewise, practitioners may need to consider other variables relevant for the individual or setting of intervention. For example, in the treatment of escape-maintained behaviors, Geiger et al. (2010) provides practitioners with a treatment-selection guide that considers variables including client goals, appropriate curriculum, and severity of the behavior. Concurrent with the functional assessment process, practitioners should also supplement findings with the use of preference assessments (Fisher et al., 1992), relevant antecedent manipulations (Smith et al., 1995), or competing stimulus assessments to identify stimuli that compete with the problem behavior. Lastly, in considering later intervention implementation, a practitioner should consider if the setting is a therapeutic environment and ensure that there is potential for those in the natural environment to reinforce the behavior change.

It is important that behavior analysts understand the behavioral principles that underpin the functional assessment and subsequent function-based interventions for challenging behavior. However, given that there are a number of variables that needed to be considered it is suggested that practitioners use a decision-making process to guide their subsequent intervention (e.g., Geiger et al., 2010).

Social Validity and Ethical Considerations

In a broad sense, social validity refers to the social significance of goals, the acceptability of procedures applied, and the importance of the outcome to the individual and others (Baer et al., 1968). When assessed specifically, the functional assessment process has achieved high ratings of acceptability from respondents including teachers (Langthorne & McGill, 2011; O'Neill et al., 2015; Sasso et al., 1992) and parents (Hanley et al., 2014; Langthorne & McGill, 2011; Taylor et al., 2018). Generally, respondents have indicated that functional analysis procedures do not tend to cause discomfort, and examinations in the literature show that analyses are relatively low risk when safeguards are applied (Kahng et al., 2015).

In addition, the accuracy of functional analysis in informing an effective treatment outweighs the potential risks or time involved in the process (Campbell, 2003). While descriptive assessments can be perceived as more acceptable, they make take longer, are significantly less accurate, and often overreport an attention function (Thompson & Iwata, 2007). There is considerable literature highlighting that function-based treatments are more effective (Campbell, 2003; Heyvaert et al., 2014; Hurl et al., 2016), and more socially valid (Plavnick & Ferreri, 2011), when compared to nonfunction-based procedures. In addition, nonfunction-based treatments are more likely to be overly complex (Kirkwood et al., 2021b), or rely on aversive procedures (Campbell, 2003; Kahng et al., 2002).

Functional assessments are a core area of practice for certified behavior analysts. However, there is considerable variation in its practical implementation (Oliver et al., 2015; Roscoe et al., 2015). Of further concern, Saini and Cox (2020) note that some BCBAs had conducted few functional analyses in their career despite working with individuals with severe behavior. Barriers identified by behavior analysts have included time for conducting analyses, appropriate physical spaces, access to support staff, and need for administrative agreement for the process (Roscoe et al., 2015). As outlined earlier, there are currently a range of empirically supported methods to address such barriers. We present some further considerations of these barriers for practitioners below that can supplement further the decision-making guidelines summarized in Fig. 5.2.

Seeking Consent or Assent Practitioners should obtain informed consent before conducting functional analysis procedures. When meeting with consumers, the practitioner should start to build a therapeutic relationship, outline benefits and risks of the process, and establish clear safety criteria. In certain settings (e.g., schools), the consent process may require stakeholder meetings with a wider group (Langthorne & McGill, 2011). During the process, significant others/caregivers should be able to observe the process if they wish to do so and thus may request that the analysis be ceased if they feel that the individual is experiencing discomfort.

If initial consent for procedures is not obtained from caregivers or the organization, practitioners may be able to take steps to provide education regarding the process. Hanley (2012) provides a range of strategies for certified behavior analysts to disseminate the value of functional analysis, such as outlining the benefits, using analogies to support understanding of the process, and discussing the functional analysis variations for the individual that improve safety and reduce time involved. Within organizations, behavior analysts may also consider events to educate administrators who may influence policy changes that allow wider access to the assessment process (Saini & Cox, 2020). Some authors have also suggested the process of structural analysis as an acceptable alternative (Stichter & Conroy, 2005), whereby antecedents are systematically manipulated (e.g., type of task, instruction), while reinforcers remain constant (e.g., escape).

Safeguards and Safety Practitioners should complete a risk–benefit analysis before proceeding with a functional assessment. Recent research discusses the development of specific risk assessments (Deochand et al., 2020) incorporating criteria such as clinical experience, environment (availability of equipment, physical safety aspects of room), support staff (those running analyses, medical oversight), and behavior intensity. In particular, for behaviors of high severity (e.g., self-injury, aggression) the functional analysis process should include prior medical examination and ongoing access to medical care if required. A high ratio of trained staff should be available to conduct procedures in an appropriate environment (e.g., padded walls) with clear session termination criteria (Kahng et al., 2015). In Iwata et al. (1994c), safeguards included observation from a physician or nurse to determine potential adjustments to termination criteria. Upon meeting criteria, the participants were immediately removed from the functional analysis room and evaluated by medical staff. Additional strategies to enhance the safety of the assessment process include: (1) clearly specified termination criteria, (2) staff training (including training in the implementation of termination criteria), (3) supervision by experienced staff and family oversight, (4) reinforcing mild occurrences of problem behavior (to avoid topography escalation), and (5) when appropriate, utilize variations of the standard model requiring fewer occurrences of problem behavior (e.g., latency-based functional analysis, precursor functional analysis).

Competency and Training Conducting functional assessments is one of the core practice areas for behavior analysts, but available data suggests that future professionals may not always receive this training as part of their education (Saini & Cox, 2020). Individuals pursuing certification as behavior analysts should only seek out programs that include sufficient training and supervision in conducting functional assessments (Hanley, 2012). Research has highlighted that functional analyses can be conducted by residential caregivers (Phillips & Mudford, 2008), teachers (Bloom et al., 2013), and, with adequate training, the process can be supported via telehealth (Bloomfield et al., 2020). However, consistent with other researchers, we caution against prioritizing this approach in practice (Hanley, 2012). Other professionals will not have the other necessary competencies involved in the process (interviewing, data analysis, single-case design), training time may still be considerable, and the certified professional must remain sufficiently involved to implement the function-based intervention. Thus, we recommend that paraprofessionals can be trained as assistants in the process, including data collection and training to act as the therapist during the analysis. Paraprofessionals can also contribute their knowledge of the individual to inform the development of the function-based intervention.

Investment of Time and Resources The standard model of functional analysis can take up to 10 h to complete with one to three staff members in attendance and requires dedicated space where the various settings of a functional analysis can be recreated. The time demands could double if we factor in ancillary assessments (e.g., preference assessments, interviews, informal observations) in addition to data processing and graphing. While these challenges are real, some variations of the standard model provide alternatives that are less resource intensive (e.g., brief functional analysis, IISCA). The model presented in Fig. 5.2 incorporates time as a decision-making factor.

Criticisms and Future Directions

The functional analysis of problem behavior has received various criticisms over the years. Some of the concerns raised have shaped the course of research in this area in an attempt to ameliorate these challenges. Some of these challenges are summarized below.

Iatrogenic Functions Because problem behavior is reinforced during a functional analysis, novel functions may be established over the course of the assessment as preferred (albeit nonfunctional) stimuli are repeatedly delivered. Thus, iatrogenic functions may be established as a by-product of the assessment leading to false-positive function identification. The available evidence suggests that assessment conditions that combine multiple contingencies may be more susceptible of iatrogenic function. This has been found to be the case for *tangible*, which invariably includes the access to a preferred item (Rooker et al., 2011), and, more recently, for synthesized contingencies, which may include simultaneous exposure to multiple reinforcing contingencies (Retzlaff et al., 2020). While there is very limited evidence in the literature indicating how pervasive iatrogenic functions might be, practitioners should closely monitor the reinforcing potency of reinforcers when combining (or *synthesizing*) contingencies.

Lack of Ecological and Social Validity While the effectiveness of functional analysis and function-based interventions is well established, the social validity of functional analysis has received little attention by comparison. Langthorne and McGill (2011) presented an ad hoc social validity questionnaire to 14 parents and 4 teachers of students that have completed a functional analysis. When asked, over a 5-point Likert scale, whether they had a positive reaction to the assessment, respondents averaged 4.15 (1, completely disagree; 5 completely agree). However, the variability in some of the responses, with some participants scoring as low as 2 to some of the acceptability items, calls for further research in this area. Álvarez et al. (2014) summarize a few strategies for maximizing the social validity of functional analysis and function-based interventions: (1) identifying treatment goals that are meaningful to the individual and their caregivers, (2) designing an individualized functional analysis incorporating elements of the natural environment, (3) adapting treatments to address multiple goals, and (4) training caregivers to implement the assessment and treatment procedures. Related to ecological and social validity, some undifferentiated functional analyses may be attributed to the idiosyncratic elements of the contingency that the individual is responding to. This finding is true whether it is a combination of antecedent variables (e.g., Call et al., 2005), an unusually long exposure to the functional contingency (e.g., Davis et al., 2012; Kahng et al., 2001), or a particular stimulus dimension of the reinforcer (e.g., attention delivered by a particular individual, see, for example, Northup et al., 1995). The remedial actions that can be taken to enhance social and ecological validity by incorporating elements of the natural environment may also be relevant in preventing undifferentiated results attributable to an idiosyncratic function.

Limitations to the Assessment of Automatic Reinforcement The automatic reinforcement outcome of a functional analysis may often provide limited information for treatment planning and subsequent assessments may be needed. For example, Goh et al. (1995) conducted functional analyses to verify that the hand mouthing of four participants was automatically maintained. Then, they evaluated the level of hand mouthing disruption caused by various forms of object manipulation (toy-mouth vs. hand-toy manipulation). Similar assessments can be found in the literature (e.g., Contrucci Kuhn & Triggs, 2009; Fisher et al., 1998; Patel et al., 2000; Piazza et al., 1998; Rooker et al., 2018). A more time-efficient approach may be to identify disruption patterns within a standard functional analysis before determining that additional assessments are required (see, for example, Virues-Ortega et al., 2022). The still-limited effectiveness of function-based interventions for automatically maintained problem behavior continues to be an area of active research (Hagopian et al., 2018: Hagopian, 2020).

Conclusion

In this chapter, we present an overview of the concept, historical development, procedural variations, and practical implications of functional analysis in applied behavior analysis. Functional analysis of problem behavior was first formalized into a compact assessment protocol by Iwata et al. (1982/1994a), and it has since become a central area of practice and research within the field. The methods for conducting a functional analysis have evolved over the years adding flexibility and adapting it to diverse settings, topographies, and populations. We may continue to see functional analysis methods coalescing into clinical decision-making systems based on the individual strengths and weaknesses of various functional assessment strategies (see Table 5.3). An additional aspect of the future development of functional analysis may be its progressive integration with complex and long-term skill acquisition programs. The interaction between functional analysis and the acquisition of verbal and social curricula may be crucial as functional analysis methodology, originally developed for populations with severe intellectual disability, expands into populations with sophisticated verbal and social repertoires, including children and adults with autism spectrum disorder.

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Appendix 1: Standard Functional Analysis Model Protocol[2]

General

Rationale The assessment presents the client with conditions that could result in problem behavior (PB). These conditions assume that either positive and negative reinforcement (either social or automatic) are consequences that maintain PB. By identifying which source of reinforcement accounts for a client's problem behavior, individualized treatment programs can be developed.

Risk management Although client protection is of paramount importance, it is best to use as little protective equipment as possible during the assessment. If physical risk is a concern, implement session termination criteria agreed with medical staff. If the behavior is so severe that all instances must be blocked, that person is not suitable to participate in a functional analysis. Refer such persons for consultation or participation in modified assessment procedures.

Location of the session Select a room away from the activity in progress; a room with a one-way window is preferable. If a one-way window is not available, observers should sit away from the client and avoid eye contact or any type of interaction.

Medication Ideally, functional testing should be performed in the absence of psychotropic medication. If this is not possible, the level of medication should be held constant until the evaluation is completed (for further details see Cox & Virues-Ortega, 2016).

[2] According to the methods by Iwata et al. (1982/1994a). Based on material developed by Dr. Brian A. Iwata, reproduced with permission of the author.

Informed consent It is important to ensure that parents, advocates, and members of the interdisciplinary team understand the purpose of the evaluation and approve of its use.

Session duration Sessions usually last 10 min, unless completion criteria are met, and are timed with a stopwatch. In the event of time constrains, it is possible to reduce session duration to 5 min.

Target behavior The behavior that is scored by observers and that receives consequences from a therapist in the demand and attention conditions. In most circumstances, each instance of the target behavior will be recorded.

Therapist This is the individual who interacts with the client. Ideally, a different therapist is associated with each of the conditions listed below (e.g., one therapist leads all attention sessions, another leads all demand sessions, etc.). If a single therapist leads all sessions, it may be helpful to wear a different color shirt when running each type of session.

Alone/Ignore/No Interaction

Objective This is a test condition for automatic reinforcement. If the behavior occurs at a high rate in the absence of social interaction, the behavior is likely to produce its own reinforcers (i.e., automatic reinforcement).

Antecedents No therapist is necessary for this condition or, if present, no social interaction should take place (including eye contact or behavior-contingent movement or proximity). The room should contain no toys, leisure materials or reinforcers.

Consequence No social consequences for the behavior (e.g., no comments or changes in facial expression).

Attention

Objective This is a test condition for positive social reinforcement. If the rate of a target behavior is higher in this condition than in other conditions, the behavior is likely to be maintained by attention as a consequence.

Antecedents The room should contain some toys or leisure materials, which are freely available during the session. Sessions begin with the therapist saying that he or she needs to "do some work" or something to that effect (i.e., not attending to the client). From this point on, the therapist does not interact with the client unless the target behavior occurs.

Consequence After each target behavior, the therapist approaches the client and makes a statement of concern, which may be accompanied by brief physical contact. For example, while saying "Don't do that, you might hurt yourself," the therapist may also gently hold the client's arm, stroke the client's back in a "reassuring" motion, or even look at and point to the location on the client's body that is suffering the injury. These interactions should last between 5 and 10 s. If the client continues the behavior during the interaction, the interaction should also continue.

Demand

Objective This is a test condition for negative social reinforcement. If a target behavior occurs more frequently in this condition, the behavior is likely to be maintained by escape from the demands of the task.

Antecedents The therapist begins the session by presenting a relevant task (e.g., an unpreferred and age-appropriate academic activity) to the client, e.g., "Peter, let's do some homework" If the client does not comply after 5 s, the therapist demonstrates the correct response or provides a tactile prompt. If the client does not comply after 5 s of the prompt, the therapist physically guides the client through the task. This form of instructional trials continues until the end of the session. It is usually best to present a variety of tasks. Consider including tasks that the client is suspected of disliking. There should be no unscripted forms of interaction between the therapist and client.

Consequence After each occurrence of a target behavior, the demands end immediately without comment from the therapist, and the next trial is delayed by about 30 s.

Play

Objective This condition functions as a control for the other three test conditions. Specifically, the client is not alone, attention is available, and no tasks are presented. As a result, the target behavior should occur less frequently in this condition. If the target behavior occurs at a high rate in this condition, it is possible that the behavior produces its own reinforcers and that alternative activities do not compete with the problem behavior.

Antecedents The room must contain known toys, leisure materials and reinforcers. The client should have free access to the objects. At 30-s intervals, the therapist should approach the client and engage in conversation for 5–10 s. In addition, the therapist should respond to any appropriate social behavior initiated by the client.

Consequence There are no consequences for problem behavior, except that care should be delayed if the problem behavior occurs just as care is about to be delivered.

Other Considerations

Sequence of conditions Assessment conditions are usually presented in an alternating sequence in the following order: *alone, attention, play, and demand*. Whenever possible, it is advisable to keep the therapist, environment, and materials within each condition constant (e.g., the same therapist, environment, and materials are used in all play sessions). These steps are taken to facilitate discrimination between assessment conditions. Sometimes, clients do not discriminate very well between the different conditions; this can produce unclear results. Therefore, two alternative arrangements are possible. In the reversal design, one continues with a single condition (e.g., gambling) until the data are stable; then the next condition (e.g., demand) is introduced, and so on. The other alternative is pairwise evaluation, in which a test condition (e.g., attention) is alternated with the control (game), followed by another test-control pair (demand vs. game), and so on.

Other conditions The above conditions represent a general set of evaluation "probes" that simulate the natural environment. Some clients have unusual histories that may require modifications of the above conditions or the addition of new conditions. For example, an individual whose problem behavior is maintained by attention might exhibit problem behavior only if another person (a peer) is receiving attention. Another may exhibit problem behavior for escape from some tasks (e.g., self-care), but not others. If the initial assessment data are unclear, application consistency has been verified, and conditions have been attempted using the reversal design, consideration should be given to systematically altering the assessment conditions.

References

Álvarez, J. P., Call, N. A., & Lomas Mevers, J. E. (2014). Increasing the social validity of function-based treatments for problem behavior. *Acta de Investigación Psicológica, 4*(3), 1683–1700. https://doi.org/10.1016/S2007-4719(14)70974-3

Ayllon, T., & Michael, J. (1959). The psychiatric nurse as a behavioral engineer. *Journal of the Experimental Analysis of Behavior, 2*(4), 323–334. https://doi.org/10.1901/jeab.1959.2-323

Bachmeyer, M. H., Piazza, C. C., Fredrick, L. D., Reed, G. K., Rivas, K. D., & Kadey, H. J. (2009). Functional analysis and treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 42*(3), 641–658. https://doi.org/10.1901/jaba.2009.42-641

Bachmeyer, M. H., Kirkwood, C. A., Criscito, A. B., Mauzy, C. R., IV, & Berth, D. P. (2019). A comparison of functional analysis methods of inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 52*(3), 603–621. https://doi.org/10.1002/jaba.556

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 1–21. https://doi.org/10.1002/jaba.30

Bihm, E. M., Kienlen, T. L., Ness, M. E., & Poindexter, A. R. (1991). Factor structure of the motivation assessment scale for persons with mental retardation. *Psychological Reports, 68*, 1235–1238.

Bloom, S. E., Iwata, B. A., Fritz, J. N., Roscoe, E. M., & Carreau, A. B. (2011). Classroom application of a trial-based functional analysis. *Journal of Applied Behavior Analysis, 44*(1), 19–31. https://doi.org/10.1901/jaba.2011.44-19

Bloom, S. E., Lambert, J. M., Dayton, E., & Samaha, A. L. (2013). Teacher-conducted trial-based functional analyses as the basis for intervention. *Journal of Applied Behavior Analysis, 46*(1), 208–218. https://doi.org/10.1002/jaba.21

Bloomfield, B. S., Fischer, A. J., King, H. C., Lehman, E. L., & Clark, R. R. (2020). Exploring implementor error during remotely conducted school-based functional analysis telehealth training package. *Journal of Applied School Psychology, 36*(4), 347–375. https://doi.org/10.1080/15377903.2020.1749204

Borlase, M. A., Vladescu, J. C., Kisamore, A. N., Reeve, S. A., & Fetzer, J. L. (2017). Analysis of precursors to multiply controlled problem behavior: A replication. *Journal of Applied Behavior Analysis, 50*, 668–674. https://doi.org/10.1002/jaba.398

Borrero, C. S., & Borrero, J. C. (2008). Descriptive and experimental analyses of potential precursors to problem behavior. *Journal of Applied Behavior Analysis, 41*, 83–96. https://doi.org/10.1901/jaba.2008.41-83

Call, N. A., Wacker, D. P., Ringdahl, J. E., & Boelter, E. W. (2005). Combined antecedent variables as motivating operations within functional analyses. *Journal of Applied Behavior Analysis, 38*(3), 385–389. https://doi.org/10.1901/jaba.2005.51-04

Campbell, J. M. (2003). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: A quantitative synthesis of single-subject research. *Research in Developmental Disabilities, 24*(2), 120–138. https://doi.org/10.1016/s0891-4222(03)00014-3

Carr, E. G., Newsom, C. D., & Binkoff, J. A. (1976). Stimulus control of self-destructive behavior in a psychotic child. *Journal of Abnormal Child Psychology, 4*(2), 139–153. https://doi.org/10.1007/BF00916518

Chezan, L., Wolfe, K., & Drasgow, E. (2017). A meta-analysis of functional communication training effects on problem behavior and alternative communicative responses. *Focus on Autism and Other Developmental Disabilities, 33*, 108835761774129. https://doi.org/10.1177/1088357617741294

Coffey, A. L., Shawler, L. A., Jessel, J., Nye, M. L., Bain, T. A., & Dorsey, M. F. (2020). Interview-informed synthesized contingency analysis (IISCA): Novel interpretations and future directions. *Behavior Analysis in Practice, 13*(1), 217–225. https://doi.org/10.1007/s40617-019-00348-3

Contrucci Kuhn, S., & Triggs, M. (2009). Analysis of social variables when an initial functional analysis indicates automatic reinforcement as the maintaining variable for self-injurious behavior. *Journal of Applied Behavior Analysis, 42*(3), 679–683. https://doi.org/10.1901/jaba.2009.42-679

Cox, A. D., & Virues-Ortega, J. (2016). Interactions between behavior function and psychotropic medication. *Journal of Applied Behavior Analysis, 49*(1), 85–104. https://doi.org/10.1002/jaba.247

Davis, B. J., Kahng, S., Schmidt, J., Bowman, L. G., & Boelter, E. W. (2012). Alterations to functional analysis methodology to clarify the functions of low rate, high intensity problem behavior. *Behavior Analysis in Practice, 5*(1), 27–39. https://doi.org/10.1007/BF03391815

Deochand, N., Eldridge, R. R., & Peterson, S. M. (2020). Toward the development of a functional analysis risk assessment decision tool. *Behavior Analysis in Practice, 13*(4), 978–990. https://doi.org/10.1007/s40617-020-00433-y

Derby, K. M., Wacker, D. P., Sasso, G., Steege, M., Northup, J., Cigrand, K., & Asmus, J. (1992). Brief functional assessment techniques to evaluate aberrant behavior. *Journal of Applied Behavior Analysis, 25*, 713–721.

Duker, P. C., & Sigafoos, J. (1998). The Motivation Assessment Scale: Reliability and construct validity across three topographies of behavior. *Research in Developmental Disabilities, 19*, 131–141.

Durand, M., & Crimmins, D. (1988). Identifying the variables maintaining self-injurious behavior. *Journal of Autism and Developmental Disorders, 18*, 99–117.

Durand, V. M., & Crimmins, D. B. (Eds.). (2011). *Guía de Administración de la Escala de Evaluación de la Motivación* [Administration manual of the Motivation Assessment Scale] (J. Virues-Ortega trans.). Topeka, KS: Monaco & Associates.

Fahmie, T. A., & Iwata, B. A. (2011). Topographical and functional properties of precursors to severe problem behavior. *Journal of Applied Behavior Analysis, 44*(4), 993–997. https://doi.org/10.1901/jaba.2011.44-993

Ferster, C. B. (1973). A functional analysis of depression. *American Psychologist, 28*(10), 857–870. https://doi.org/10.1037/h0035605

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491–498. https://doi.org/10.1901/jaba.1992.25-491

Fisher, W. W., Lindauer, S. E., Alterson, C. J., & Thompson, R. H. (1998). Assessment and treatment of destructive behavior maintained by stereotypic object manipulation. *Journal of Applied Behavior Analysis, 31*(4), 513–527. https://doi.org/10.1901/jaba.1998.31-513

Fisher, W. W., Greer, B. D., Romani, P. W., Zangrillo, A. N., & Owen, T. M. (2016). Comparisons of synthesized and individual reinforcement contingencies during functional analysis. *Journal of Applied Behavior Analysis, 49*(3), 596–616. https://doi.org/10.1002/jaba.314

Freeman, K. A., Walker, M., & Kaufman, J. (2007). Psychometric properties of the questions about behavioral function scale in a child sample. *American Journal of Mental Retardation, 112*, 122–129.

Friedman, A., & Luiselli, J. K. (2008). Excessive daytime sleep: Behavioral assessment and intervention in a child with autism. *Behavior Modification, 32*(4), 548–555. https://doi.org/10.1177/0145445507312187

Fritz, J. N., Iwata, B. A., Hammond, J. L., & Bloom, S. E. (2013). Experimental analysis of precursors to severe problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 101–129. https://doi.org/10.1002/jaba.27

Geiger, K. B., Carr, J. E., & LeBlanc, L. A. (2010). Function-based treatments for escape-maintained problem behavior: A treatment-selection model for practicing behavior analysts. *Behavior Analysis in Practice, 3*(1), 22–32. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3004681/

Gerhardt, P. F., Weiss, M. J., & Delmolino, L. (2004). Treatment of severe aggression in an adolescent with autism: Non-contingent Reinforcement and Functional Communication Training. *The Behavior Analyst Today, 4*(4), 386. https://doi.org/10.1037/h0100124

Goh, H. L., Iwata, B. A., Shore, B. A., DeLeon, I. G., Lerman, D. C., Ulrich, S. M., & Smith, R. G. (1995). An analysis of the reinforcing properties of hand mouthing. *Journal of Applied Behavior Analysis, 28*(3), 269–283. https://doi.org/10.1901/jaba.1995.28-269

Grace, N. C., Thompson, R., & Fisher, W. W. (1996). The treatment of covert self-injury through contingencies on response products. *Journal of Applied Behavior Analysis, 29*(2), 239–242. https://doi.org/10.1901/jaba.1996.29-239

Greer, B. D., Fisher, W. W., Saini, V., Owen, T. M., & Jones, J. K. (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. *Journal of Applied Behavior Analysis, 49*(1), 105–121. https://doi.org/10.1002/jaba.265

Griffith, K. R., Price, J. N., & Penrod, B. (2019). The effects of a self-instruction package and group training on trial-based functional analysis administration. *Behavior Analysis in Practice, 13*(1), 63–80. https://doi.org/10.1007/s40617-019-00388-9

Hagopian, L. P. (2020). The consecutive controlled case series: Design, data-analytics, and reporting methods supporting the study of generality. *Journal of Applied Behavior Analysis, 53*(2), 596–619. https://doi.org/10.1002/jaba.691

Hagopian, L. P., Fisher, W. W., Thompson, R. H., Owen-DeSchryver, J., Iwata, B. A., & Wacker, D. P. (1997). Toward the development of structured criteria for interpretation of functional analysis data. *Journal of Applied Behavior Analysis, 30*(2), 313–326. https://doi.org/10.1901/jaba.1997.30-313

Hagopian, L. P., Rooker, G. W., & Yenokyan, G. (2018). Identifying predictive behavioral markers: A demonstration using automatically reinforced self-injurious behavior. *Journal of Applied Behavior Analysis, 51*(3), 443–465. https://doi.org/10.1002/jaba.477

Hammond, J. L., Iwata, B. A., Rooker, G. W., Fritz, J. N., & Bloom, S. E. (2013). Effects of fixed versus random condition sequencing during multielement functional analyses. *Journal of Applied Behavior Analysis, 46*(1), 22–30. https://doi.org/10.1002/jaba.7

Hanley, G. P. (2005). *Sleep assessment and treatment tool.* https://practicalfunctionalassessment.files.wordpress.com/2015/06/satt.pdf

Hanley, G. P. (2012). Functional assessment of problem behavior: Dispelling myths, overcoming implementation obstacles, and developing new lore. *Behavior Analysis in Practice, 5*(1), 54–72. https://doi.org/10.1007/BF03391818

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47*(1), 16–36. https://doi.org/10.1002/jaba.106

Harding, J. W., Wacker, D. P., Berg, W. K., Barretto, A., Winborn, L., & Gardner, A. (2001). Analysis of response class hierarchies with attention-maintained problem behaviors. *Journal of Applied Behavior Analysis, 34*(1), 61–64. https://doi.org/10.1901/jaba.2001.34-61

Haynes, S. N., & O'Brien, W. H. (1990). Functional analysis in behavior therapy. *Clinical Psychology Review, 10*(6), 649–668. https://doi.org/10.1016/0272-7358(90)90074-K

Haynes, S. N., & O'Brien, W. H. (2000). *Principles and practice of behavioral assessment*. Kluwer Academic Publishers. https://doi.org/10.1007/978-0-306-47469-9

Heath, H., Jr., & Smith, R. G. (2019). Precursor behavior and functional analysis: A brief review. *Journal of Applied Behavior Analysis, 52*(3), 804–810. https://doi.org/10.1002/jaba.571

Herscovitch, B., Roscoe, E. M., Libby, M. E., Bourret, J. C., & Ahearn, W. H. (2009). A procedure for identifying precursors to problem behavior. *Journal of Applied Behavior Analysis, 42*, 697–702. https://doi.org/10.1901/jaba.2009.42-697

Herzinger, C. V., & Campbell, J. M. (2007). Comparing functional assessment methodologies: A quantitative synthesis. *Journal of Autism and Developmental Disorders, 37*(8), 1430–1445. https://doi.org/10.1007/s10803-006-0219-6

Heyvaert, M., Saenen, L., Campbell, J. M., Maes, B., & Onghena, P. (2014). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: An updated quantitative synthesis of single-subject research. *Research in Developmental Disabilities, 35*(10), 2463–2476. https://doi.org/10.1016/j.ridd.2014.06.017

Hurl, K., Wightman, J. K., Haynes, S. N., & Virues-Ortega, J. (2016). Does a pre-intervention functional assessment increase intervention effectiveness? A meta-analysis of within-subject interrupted time-series studies. *Clinical Psychology Review, 47*, 71–84. https://doi.org/10.1016/j.cpr.2016.05.003

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994a). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. https://doi.org/10.1901/jaba.1994.27-197. (Original published in 1982).

Iwata, B. A., Duncan, B. A., Zarcone, J. R., Lerman, D. C., & Shore, B. A. (1994b). A sequential, test-control methodology for conducting functional analyses of self-injurious behavior. *Behavior Modification, 18*(3), 289–306. https://doi.org/10.1177/01454455940183003

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., Lerman, D. C., Shore, B. A., & Mazalesk, J. L. (1994c). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27*(2), 215–240. https://doi.org/10.1901/jaba.1994.27-215

Iwata, B. A., Deleon, I. G., & Roscoe, E. M. (2013). Reliability and validity of the functional analysis screening tool. *Journal of Applied Behavior Analysis, 46*(1), 271–284. https://doi.org/10.1002/jaba.31

Iwata, B. A., DeLeon, I. G., & Roscoe, E. M. (2020). *Instrumento de Cribado para Análisis Funcional (Functional Analysis Screening Tool, FAST), versión en español* (J. Virues-Ortega, trans.). ABA España. https://doi.org/10.26741/2020.fast

Jessel, J., Ingvarsson, E. T., Metras, R., Kirk, H., & Whipple, R. (2018). Achieving socially significant reductions in problem behavior following the interview-informed synthesized contingency analysis: A summary of 25 outpatient applications. *Journal of Applied Behavior Analysis, 51*(1), 130–157. https://doi.org/10.1002/jaba.436

Jin, C. S., Hanley, G. P., & Beaulieu, L. (2013). An individualized and comprehensive approach to treating sleep problems in young children. *Journal of Applied Behavior Analysis, 46*(1), 161–180. https://doi.org/10.1002/jaba.16

Joosten, A. V., & Bundy, A. C. (2008). The motivation of stereotypic and repetitive behavior: Examination of construct validity of the Motivation Assessment Scale. *Journal of Autism and Developmental Disorders, 38*, 1341–1348.

Kadey, H., Piazza, C. C., Rivas, K. M., & Zeleny, J. (2013). An evaluation of texture manipulations to increase swallowing. *Journal of Applied Behavior Analysis, 46*(2), 539–543. https://doi.org/10.1002/jaba.33

Kahng, S. W., Abt, K. A., & Schonbachler, H. E. (2001). Assessment and treatment of low-rate high-intensity problem behavior. *Journal of Applied Behavior Analysis, 34*(2), 225–228. https://doi.org/10.1901/jaba.2001.34-225

Kahng, S., Iwata, B., & Lewin, A. (2002). Behavioral treatment of self-injury, 1964 to 2000. *American Journal of Mental Retardation, 107*, 212–221. https://doi.org/10.1352/0895-8017(2002)107<0212:BTOSIT>2.0.CO;2

Kahng, S., Hausman, N. L., Fisher, A. B., Donaldson, J. M., Cox, J. R., Lugo, M., & Wiskow, K. M. (2015). The safety of functional analyses of self-injurious behavior. *Journal of Applied Behavior Analysis, 48*(1), 107–114. https://doi.org/10.1002/jaba.168

Kearney, C. A. (1994). Interrater reliability of the Motivation Assessment Scale: Another, closer look. *Journal of the Association for Persons with Severe Handicaps, 19*, 139–142.

Kearney, C. A., Cook, C., Chapman, G., & Bensaheb, A. (2006). Exploratory and confirmatory factor analyses of the Motivation Assessment Scale and Resident Choice Assessment Scale. *Journal of Developmental and Physical Disabilities, 18*, 2–11.

Kirkwood, C. A., Bachmeyer-Lee, M. H., Sheehan, C. M., Mauzy, C. R., IV, & Gibson, L. A. (2021a). Further examination of the treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied*

Behavior Analysis, 54(1), 429–450. https://doi.org/10.1002/jaba.738

Kirkwood, C. A., Piazza, C. C., & Peterson, K. M. (2021b). A comparison of function-and nonfunction-based extinction treatments for inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 54*(3), 928–945. https://doi.org/10.1002/jaba.825

Koritsas, S., & Iacono, T. (2013). Psychometric comparison of the Motivation Assessment Scale (MAS) and the Questions About Behavioral Function (QABF). *Journal of Intellectual Disability Research, 57*(8), 747–757. https://doi.org/10.1111/jir.12022

Langthorne, P., & McGill, P. (2011). Assessing the social acceptability of the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 44*(2), 403–407. https://doi.org/10.1901/jaba.2011.44-403

Lequia, J., Wilkerson, K. L., Kim, S., & Lyons, G. L. (2015). Improving transition behaviors in students with autism spectrum disorders: A comprehensive evaluation of interventions in educational settings. *Journal of Positive Behavior Interventions, 17*(3), 146–158.

Lerman, D. C., Parten, M., Addison, L. R., Vorndran, C. M., Volkert, V. M., & Kodak, T. (2005). A methodology for assessing the functions of emerging speech in children with developmental disabilities. *Journal of Applied Behavior Analysis, 38*(3), 303–316. https://doi.org/10.1901/jaba.2005.106-04

Lydon, S., Healy, O., O'Reilly, M. F., & Lang, R. (2012). Variations in functional analysis methodology: A systematic review. *Journal of Developmental and Physical Disabilities, 24*(3), 301–326. https://doi.org/10.1007/s10882-012-9267-3

Martens, B. K., Digennaro, F. D., Reed, D. D., Szczech, F. M., & Rosenthal, B. D. (2008). Contingency space analysis: An alternative method for identifying contingent relations from observational data. *Journal of Applied Behavior Analysis, 41*(1), 69–81. https://doi.org/10.1901/jaba.2008.41-69

McCord, B. E., & Neef, N. A. (2005). Leisure items as controls in the attention condition of functional analyses. *Journal of Applied Behavior Analysis, 38*(3), 417–426. https://doi.org/10.1901/jaba.2005.116-04

McCord, B. E., Thomson, R. J., & Iwata, B. A. (2001). Functional analysis and treatment of self-injury associated with transitions. *Journal of Applied Behavior Analysis, 34*(2), 195–210. https://doi.org/10.1901/jaba.2001.34-195

McLay, L., France, K., Blampied, N., Danna, K., & Hunter, J. (2017). Using functional behavioral assessment to develop a multicomponent treatment for sleep problems in a 3-year-old boy with autism. *Clinical Case Studies, 16*(3), 254–270. https://doi.org/10.1177/1534650116688558

McLay, L., France, K., Blampied, N., & Hunter, J. (2019a). Using functional behavioral assessment to treat sleep problems in two children with autism and vocal stereotypy. *International Journal of Developmental Disabilities, 65*(3), 175–184. https://doi.org/10.1080/20473869.2017.1376411

McLay, L. K., France, K. G., Knight, J., Blampied, N. M., & Hastie, B. (2019b). The effectiveness of function-based interventions to treat sleep problems, including unwanted co-sleeping, in children with autism. *Behavioral Interventions, 34*(1), 30–51. https://doi.org/10.1002/bin.1651

Muething, C. S., Call, N. A., Lomas Mevers, J., Zangrillo, A. N., Clark, S. B., & Reavis, A. R. (2017). Correspondence between the results of functional analyses and brief functional analyses. *Developmental Neurorehabilitation, 20*(8), 549–559. https://doi.org/10.1080/17518423.2017.1338776

Najdowski, A. C., Wallace, M. D., Penrod, B., Tarbox, J., Reagon, K., & Higbee, T. S. (2008). Caregiver-conducted experimental functional analyses of inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 41*(3), 459–465. https://doi.org/10.1901/jaba.2008.41-459

Neidert, P. L., Iwata, B. A., Dempsey, C. M., & Thomason-Sassi, J. L. (2013). Latency of response during the functional analysis of elopement. *Journal of Applied Behavior Analysis, 46*(1), 312–316. https://doi.org/10.1002/jaba.11

Ninci, J., Vannest, K. J., Willson, V., & Zhang, N. (2015). Interrater agreement between visual analysts of single-case data: A meta-analysis. *Behavior Modification, 39*(4), 510–541. https://doi.org/10.1177/0145445515581327

Normand, M. P., Severtson, E. S., & Beavers, G. A. (2008). A functional analysis of non-vocal verbal behavior of a young child with autism. *The Analysis of Verbal Behavior, 24*(1), 63–67. https://doi.org/10.1007/BF03393057

Northup, J., Broussard, C., Jones, K., George, T., Vollmer, T. R., & Herring, M. (1995). The differential effects of teacher and peer attention on the disruptive classroom behavior of three children with a diagnosis of attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 28*(2), 227–228. https://doi.org/10.1901/jaba.1995.28-227

O'Neill, R. E., Bundock, K., Kladis, K., & Hawken, L. S. (2015). Acceptability of functional behavioral assessment procedures to special educators and school psychologists. *Behavioral Disorders, 41*(1), 51–66. https://doi.org/10.17988/0198-7429-41.1.51

Oliver, A. C., Pratt, L. A., & Normand, M. P. (2015). A survey of functional behavior assessment methods used by behavior analysts in practice. *Journal of Applied Behavior Analysis, 48*(4), 817–829. https://doi.org/10.1002/jaba.256

Ollington, N. (2016). Comparison of a direct and an indirect approach for the functional assessment of insistence on sameness in a child with autism spectrum disorder and a typically developing child. *Developmental Neurorehabilitation, 19*(1), 38–45. https://doi.org/10.3109/17518423.2014.898161

Paclawskyj, T. R., Matson, J. L., Rush, K. S., Smalls, Y., & Vollmer, T. R. (2001). Assessment of the convergent validity of the Questions About Behavioral Function Scale with analogue functional analysis and the Motivation Assessment Scale. *Journal of Intellectual Disability Research, 45*, 484–494. https://doi.org/10.1046/j.1365-2788.2001.00364.x

Patel, M. R., Carr, J. E., Kim, C., Robles, A., & Eastridge, D. (2000). Functional analysis of aberrant behavior maintained by automatic reinforcement: Assessments of specific sensory reinforcers. *Research in Developmental Disabilities, 21*(5), 393–407. https://doi.org/10.1016/S0891-4222(00)00051-2

Patel, M. R., Piazza, C. C., Santana, C. M., & Volkert, V. M. (2002). An evaluation of food type and texture in the treatment of a feeding problem. *Journal of Applied Behavior Analysis, 35*(2), 183–186. https://doi.org/10.1901/jaba.2002.35-183

Phillips, K. J., & Mudford, O. C. (2008). Functional analysis skills training for residential caregivers. *Behavioral Interventions, 23*(1), 1–12. https://doi.org/10.1002/bin.252

Phillips, C. L., Iannaccone, J. A., Rooker, G. W., & Hagopian, L. P. (2017). Noncontingent reinforcement for the treatment of severe problem behavior: An analysis of 27 consecutive applications. *Journal of Applied Behavior Analysis, 50*(2), 357–376. https://doi.org/10.1002/jaba.376

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L., Worsdell, S., Lindauer, S. E., & Keeney, K. M. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31*(2), 165–189. https://doi.org/10.1901/jaba.1998.31-165

Piazza, C. C., Fisher, W. W., Brown, K. A., Shore, B. A., Patel, M. R., Katz, R. M., Sevin, B. M., Gulotta, C. S., & Blakely-Smith, A. (2003). Functional analysis of inappropriate mealtime behaviors. *Journal of Applied Behavior Analysis, 36*(2), 187–204. https://doi.org/10.1901/jaba.2003.36-187

Plavnick, J. B., & Ferreri, S. J. (2011). Establishing verbal repertoires in children with autism using function-based video modeling. *Journal of Applied Behavior Analysis, 44*(4), 747–766. https://doi.org/10.1901/jaba.2011.44-747

Plavnick, J. B., & Normand, M. P. (2013). Functional analysis of verbal behavior: A brief review. *Journal of Applied Behavior Analysis, 46*(1), 349–353. https://doi.org/10.1002/jaba.1

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Virues-Ortega, J., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46*(1), 47–60. https://doi.org/10.1002/jaba.26

Retzlaff, B. J., Fisher, W. W., Akers, J. S., & Greer, B. D. (2020). A translational evaluation of potential iatrogenic effects of single and combined contingencies during functional analysis. *Journal of Applied Behavior Analysis, 53*(1), 67–81. https://doi.org/10.1002/jaba.595

Richman, D. M., Barnard-Brak, L., Grubb, L., Bosch, A., & Abby, L. (2015). Meta-analysis of noncontingent reinforcement effects on problem behavior. *Journal of Applied Behavior Analysis, 48*(1), 131–152. https://doi.org/10.1002/jaba.189

Rispoli, M., Ninci, J., Neely, L., & Zaini, S. (2014). A systematic review of trial-based functional analysis of challenging behavior. *Journal of Developmental and Physical Disabilities, 26*(3), 271–283. https://doi.org/10.1007/s10882-013-9363-z

Rivas, K. D., Piazza, C. C., Patel, M. R., & Bachmeyer, M. H. (2010). Spoon distance fading with and without escape extinction as treatment for food refusal. *Journal of Applied Behavior Analysis, 43*(4), 673–683. https://doi.org/10.1901/jaba.2010.43-673

Rooker, G. W., Iwata, B. A., Harper, J. M., Fahmie, T. A., & Camp, E. M. (2011). False-positive tangible outcomes of functional analyses. *Journal of Applied Behavior Analysis, 44*(4), 737–745. https://doi.org/10.1901/jaba.2011.44-737

Rooker, G. W., Bonner, A. C., Dillon, C. M., & Zarcone, J. R. (2018). Behavioral treatment of automatically reinforced SIB: 1982–2015. *Journal of Applied Behavior Analysis, 51*(4), 974–997. https://doi.org/10.1002/jaba.492

Roscoe, E. M., Phillips, K. M., Kelly, M. A., Farber, R., & Dube, W. V. (2015). A statewide survey assessing practitioners' use and perceived utility of functional assessment. *Journal of Applied Behavior Analysis, 48*(4), 830–844. https://doi.org/10.1002/jaba.259

Ruiz-Sancho, E. M., Froján-Parga, M. X., & Calero-Elvira, A. (2013). Functional analysis of the verbal interaction between psychologist and client during the therapeutic process. *Behavior Modification, 37*(4), 516–542. https://doi.org/10.1177/0145445513477127

Saini, V., & Cox, A. (2020). Functional behavior assessment practices used by Canadian Behavioral Health Practitioners. *Journal of Policy and Practice in Intellectual Disabilities, 17*(2), 157–164. https://doi.org/10.1111/jppi.12327

Saini, V., Jessel, J., Iannaccone, J. A., & Agnew, C. (2019a). Efficacy of functional analysis for informing behavioral treatment of inappropriate mealtime behavior: A systematic review and meta-analysis. *Behavioral Interventions, 34*(2), 231–247. https://doi.org/10.1002/bin.1664

Saini, V., Kadey, H. J., Paszek, K. J., & Roane, H. S. (2019b). A systematic review of functional analysis in pediatric feeding disorders. *Journal of Applied Behavior Analysis, 52*(4), 1161–1175. https://doi.org/10.1002/jaba.637

Sasso, G. M., Reimers, T. M., Cooper, L. J., Wacker, D., Berg, W., Steege, M., Kelly, L., & Allaire, A. (1992). Use of descriptive and experimental analyses to identify the functional properties of aberrant behavior in school settings. *Journal of Applied Behavior Analysis, 25*(4), 809–821. https://doi.org/10.1901/jaba.1992.25-809

Scheithauer, M., Call, N. A., Lomas Mevers, J., McCracken, C. E., & Scahill, L. (2021). A feasibility randomized clinical trial of a structured function-based intervention for elopement in children with

Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 51*(8), 2866–2875. https://doi.org/10.1007/s10803-020-04753-4

Schlichenmeyer, K. J., Roscoe, E. M., Rooker, G. W., Wheeler, E. E., & Dube, W. V. (2013). Idiosyncratic variables that affect functional analysis outcomes: A review (2001–2010). *Journal of Applied Behavior Analysis, 46*(1), 339–348. https://doi.org/10.1002/jaba.12

Shogren, K. A., & Rojahn, J. (2003). Convergent reliability and validity of the questions about behavioral function and the motivation assessment scale: A replication study. *Journal of Developmental and Physical Disabilities, 15*, 367–375.

Sigafoos, J., Kerr, M., & Roberts, D. (1994). Interrater reliability of the Motivation Assessment Scale: Failure to replicate with aggressive behavior. *Research in Developmental Disabilities, 15*, 333–342.

Singh, N. N., Donatelli, L. S., Best, A., & Williams, D. E. (1993). Factor structure of the Motivation Assessment scale. *Journal of Intellectual Disability Research, 37*, 65–74.

Skinner, B. F. (2014). *Science and human behavior.* B.F. Skinner Foundation. (Original published in 1953).

Slaton, J. D., Hanley, G. P., & Raftery, K. J. (2017). Interview-informed functional analyses: A comparison of synthesized and isolated components. *Journal of Applied Behavior Analysis, 50*(2), 252–277. https://doi.org/10.1002/jaba.384

Smith, R. G., & Churchill, R. M. (2002). Identification of environmental determinants of behavior disorders through functional analysis of precursor behaviors. *Journal of Applied Behavior Analysis, 35*(2), 125–136. https://doi.org/10.1901/jaba.2002.35-125

Smith, R. G., Iwata, B. A., Goh, H.-L., & Shore, B. A. (1995). Analysis of establishing operations for self-injury maintained by escape. *Journal of Applied Behavior Analysis, 28*(4), 515–535. https://doi.org/10.1901/jaba.1995.28-515

Smith, C. M., Smith, R. G., Dracobly, J. D., & Pace, A. P. (2012). Multiple-respondent anecdotal assessments: An analysis of interrater agreement and correspondence with analogue assessment outcomes. *Journal of Applied Behavior Analysis, 45*(4), 779–795. https://doi.org/10.1901/jaba.2012.45-779

Spencer, T. D., Detrich, R., & Slocum, T. A. (2012). Evidence-based practice: A framework for making effective decisions. *Education and Treatment of Children, 35*(2), 127–151. https://doi.org/10.1353/etc.2012.0013

Spreat, S., & Connelly, L. (1996). A reliability analysis of the Motivation Assessment Scale. *American Journal on Mental Retardation, 100*, 528–532.

Stichter, J. P., & Conroy, M. A. (2005). Using structural analysis in natural settings: A responsive functional assessment strategy. *Journal of Behavioral Education, 14*(1), 19–34. https://doi.org/10.1007/s10864-005-0959-y

Tarbox, J., Wallace, M. D., Tarbox, R. S. F., Landaburu, H. J., & Williams, W. L. (2004). Functional analysis and treatment of low-rate problem behavior in individuals with developmental disabilities. *Behavioral Interventions, 19*(2), 73–90. https://doi.org/10.1002/bin.156

Taylor, S. A., Phillips, K. J., & Gertzog, M. G. (2018). Use of synthesized analysis and informed treatment to promote school reintegration. *Behavioral Interventions, 33*(4), 364–379. https://doi.org/10.1002/bin.1640

Thomason-Sassi, J. L., Iwata, B. A., Neidert, P. L., & Roscoe, E. M. (2011). Response latency as an index of response strength during functional analyses of problem behavior. *Journal of Aplied Behavior Analysis, 44*(1), 51–67. https://doi.org/10.1901/jaba.2011.44-51

Thompson, R. H., & Iwata, B. A. (2007). A comparison of outcomes from descriptive and functional analyses of problem behavior. *Journal of Applied Behavior Analysis, 40*(2), 333–338. https://doi.org/10.1901/jaba.2007.56-06

Tiger, J. H., & Effertz, H. M. (2021). On the validity of data produced by isolated and synthesized contingencies during the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 54*(3), 853–876. https://doi.org/10.1002/jaba.792

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis, 21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Virues-Ortega, J. (2019). *Big Eye Observer* (version 2.0). [Mobile app]. https://goo.gl/x7puMW

Virues-Ortega, J., Segui-Duran, D., Descalzo-Quero, A., Carnerero, J. J., & Martin, N. (2011). Caregivers' agreement and validity of indirect functional analysis: A cross cultural evaluation across multiple problem behavior topographies. *Journal of Autism and Developmental Disorders, 41*(1), 82–91. https://doi.org/10.1007/s10803-010-1022-y

Virues-Ortega, J., Moeyaert, M., Sivaraman, M., & Fernandez Castilla, B. (2022). Quantifying outcomes in applied behavior analysis through visual and statistical analyses: A synthesis. In J. L. Matson (Ed.), *Applied behavior analysis: A comprehensive handbook*. Springer Nature.

Vollmer, T. R., Marcus, B. A., Ringdahl, J. E., & Roane, H. S. (1995). Progressing from brief assessments to extended functional analyses in the evaluation of aberrant behavior. *Journal of Applied Behavior Analysis, 28*, 561–576. https://doi.org/10.1901/jaba.1995.28-561

Wasano, L. C., Borrero, J. C., & Kohn, C. S. (2009). Brief report: A comparison of indirect versus experimental strategies for the assessment of pica. *Journal of Autism* *and Developmental Disorders, 39*(11), 1582. https://doi.org/10.1007/s10803-009-0766-8

Weaver, E. S., & Lloyd, B. P. (2018). Randomization tests for single case designs with rapidly alternating conditions: An analysis of *p*-values from published experiments. *Perspectives on Behavior Science, 42*(3), 617–645. https://doi.org/10.1007/s40614-018-0165-6

Weston, R., Hodges, A., & Davis, T. N. (2018). Differential reinforcement of other behaviors to treat challenging behaviors among children with autism: A systematic and quality review. *Behavior Modification, 42*(4), 584–609. https://doi.org/10.1177/0145445517743487

Wightman, J., Julio, F., & Virues-Ortega, J. (2014). Advances in the functional analysis and treatment of problem behavior. *Psicothema, 26*, 186–192. https://doi.org/10.7334/psicothema2013.142

Wilder, D. A., Chen, L., Atwell, J., Pritchard, J., & Weinstein, P. (2006). Brief functional analysis and treatment of tantrums associated with transitions in preschool children. *Journal of Applied Behavior Analysis, 39*(1), 103–107. https://doi.org/10.1901/jaba/2006.66-04

Zarcone, J. R., Rodgers, T. A., Iwata, B. A., Rourke, D. A., & Dorsey, M. F. (1991). Reliability analysis of the Motivation Assessment Scale: A failure to replicate. *Research in Developmental Disabilities, 12*(4), 349–360. https://doi.org/10.1016/0891-4222(91)90031-M

Operational Definitions, Observation, and Behavioral Recording in Applied Behavior Analysis

6

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Introduction

The prevalence of autism spectrum disorder (ASD) has exponentially increased in the past decade. The most recent CDC report indicates 1 in 54 children with the age of 8 in the 2018 survey, which is increased from 1 in 150 children of the same age group in 2000 and 2002 (Maenner et al., 2021). Individuals with ASD are characterized by deficits in social communication and repetitive and restricted interests (DSM-5 American Psychiatric Association 2013). Besides the progress on diagnostic tools (Jick & Kaye, 2003; Matson & Kozlowski, 2011) and research to identify genetic factors (Timothy et al., 2013), the causes of ASD are yet unknown (Ahearn & Tiger, 2013; Landrigan et al., 2012; Ronald & Hoekstra, 2011). However, it is clear that early intensive behavior intervention is effective in alleviating symptoms of ASD (Eldevik et al., 2010). Assessing the progress of the individuals and the impact of the behavioral technologies with accurate and reliable measurement of the target behavior is inevitable in behavior analytic interventions and requires on-going behavioral observation.

Skinner (1938) described difficulties gaining consensus to apply natural science approaches on human behaviors as, "Behavior has that kind of complexity or intricacy which discourages simple description and in which magical explanatory concepts flourish abundantly" (p. 3) in, "*The behavior of organism: An experimental analysis.*" While components of Skinner's approaches were not entirely novel (Morris et al., 2005), Skinner developed the experimental methods to study organisms' behaviors as subject matter. Key features of his approaches are the application of scientific procedures, description, prediction, and control, as well as observation of behaviors and identifying functional relationships between behaviors and environments. These became the basis for seven dimensions of applied behavior analysis formalized by Baer et al. (1968).

After several decades of application of natural science on animal behavior, Baer et al. (1968) identified seven dimensions of applying principles of behavior analysis into human behaviors to address social problems. These seven dimensions are applied, behavioral, analytic, technological, conceptually systematic, effective, and generality (Baer et al., 1968). The behavior of interest should be important for individuals and society (applied), and human behaviors are observed and quantified through observation (behavioral). The functional relationship is demonstrated (analytic), procedures are clearly described (technological), and the application of procedures is consistent with principles of behavior analysis (conceptually systematic). Further, the application of interventions should produce socially significant changes (effective), and the produced changes should last and be beyond trained settings, behaviors, and instructors (generality).

One of the most important contributions of Skinner was employing reliable and accurate measurements of the behavior of organisms (Baer et al., 1968; Morris et al., 2005). Along with the other dimensions of applied behavior analysis, these features have made the science of behavior possible and applicable to our society.

This chapter encompasses behavioral observation, including (1) defining behaviors, (2) measurable dimensions, (3) derivative measures, (4) discontinuous measures, and (5) elements of optimal behavior measurement. Furthermore, each section describes the application of such measurements with real-world clinical examples that include individuals diagnosed with ASD.

Target Behaviors

In applied behavior analysis, before observing a behavior, a target behavior must be selected and defined. Selected behaviors should hold social relevance and be important to the individual whose behavior is being observed. Social validity, or an assessment of whether the behavior change being targeted is acceptable and efficient for the individual and others who are affected by the behavior change, is an essential element when selecting a target behavior for observation and intervention (Wolf, 1978; Van Houten, 1979). When working with children with ASD, family and teacher input is important in selecting target behaviors and some intervention studies have included an evaluation of the value that parents and teachers place on the behavioral goals that are set (e.g., Kuhn et al., 2017). However, given that social validity measures need to involve the person whose behavior is being targeted, targeted behaviors should be of importance to the child with ASD. A socially valid selection of a target behavior should aim to include targeted behavior change that involves important consequences beyond the behavior change itself, referred to as a behavioral cusp (Rosales-Ruiz & Baer, 1997). A model proposed for selecting target behaviors is based on the concept of behavioral cusps (Bosch & Fuqua, 2001), which proposes the following guidelines when selecting a target behavior: (a) it should provide access to new reinforcers, contingencies, or environments; (b) it should be socially valid; (c) it is generalizable across settings/contexts, people, and behaviors; (d) it can compete with and serve to replace inappropriate behaviors that serve a similar function; and (e) change in the behavior will have an important effect for the individual and others closely involved in the individual's life.

Defining Target Behavior

Before observing and changing behavior, behavior must first be defined. The target behavior should be defined based upon the behavior of interest as opposed to defining behavior in terms of behavior that is not preferred to occur. To illustrate, suppose a Board Certified Behavior Analyst (BCBA) is consulting with teacher about a student in his classroom. The teacher shares a concern about the student continuously leaving their chair and suggests that the behavior be tracked. Alternatively, given the aim is to increase in-seat behavior to favorably impact academic gains of the student in the classroom context, the BCBA suggests that the behavior is defined to capture dimensions of in-seat behavior. This shift allows those who are tracking the behavior to capture the favorable response, as opposed to behavior that is unpreferred in the context.

To define a target behavior, it is necessary to know what the intended behavior, or more precisely, the response (i.e., single instance of behavior) or response class (i.e., different instances of behavior that similarly affect the environment) should be identified. This initial step of defining a target behavior accurately when working with children with ASD is critical because it forms the basis of effective behavioral intervention and measurement. This is a particularly relevant consideration in regard to a response class given that sometimes it may be more difficult to define the entire class rather than a single response. Responses that are clustered together into a response class do not similarly affect the environment, thus posing a challenge to target and effectively measure the class of behavior.

Specificity and sensitivity are key to consider when defining a target behavior and when determining what should be included in a response class (Johnston & Pennypacker, 2010). Specificity indicates that a definition must clearly state the criteria for both inclusion and exclusion so that responses that are included in a response class versus those that are not can be clearly identified. In other words, specificity refers to the aim of a response class/target behavior to only capture the behaviors that it is intended to capture while excluding those behaviors that do not produce a similar effect on the environment. Sensitivity means that the definition should capture enough of the variability of the response class. Therefore, sensitivity refers to the ability of the definition to capture all the responses that could drive behavior change. Monitoring of both specificity and sensitivity of the target behavior throughout both the assessment and intervention process is essential to allow for accurate measurement of the targeted behaviors.

For successful ongoing monitoring of a target behavior, it is crucial team that all members of the team contribute to defining the target behavior and closely monitor its sensitivity and specificity. Crucial to ongoing monitoring, parents and teachers generally interact with children most often and it is crucial that they be included in the defining and monitoring process, and at times receive training/consultation and feedback on (e.g., Martens et al., 1997) the process of identifying and defining target behaviors from the BCBA. Johnston and Pennypacker, (2010) discussed a sequential process to guide selecting and defining a target behavior: (a) consider the characteristics of the response class; (b) decide on if the behavior should be defined topographically or functionally, both of which will be discussed shortly in this chapter; (c) write a target behavior that captures what responses should be included and excludes those responses that should not be; (d) observe the behavior in order to appropriately adjust and refine the definition prior to data collection; (e) select a dimension of measurement that appropriately matches the target behavior as will be discussed later in this chapter; and (f) implement the assessment or intervention that includes the selected target behavior and measurement system.

When defining a target behavior, consider whether the behavior is a free operant (i.e., a behavior that is "free" or available to occur at any time with a clear beginning and end), or if the behavior can only occur during limited times and thus, not occur freely. This consideration will aid in accurate measurement procedures and the development of an adequate, precise definition of the target behavior. Additionally, even when following the steps laid out by Johnston et al., behavior definitions may need to be adjusted during an assessment and intervention as needed based on the behaviors being displayed and needs of the child.

The Importance of Precise Definitions

A clear, precise, and objective definition of target behaviors is important for both researchers and clinicians. The precision of a target behavior can affect both the reliability and validity of assessments and interventions. Reliability refers to the agreement between two or more different observers who measure the same behavior (Kazdin, 1977). For both observers to score in agreement with one another, the targeted behavior must be precisely defined. For example, if two observers were watching a child with ASD in a classroom and scoring behavior defined as "aggressive," this would lack in precision. Erroneously, one observer might score only instances of physical aggression, whereas the second observer might score instances of both physical and verbal aggression. An alternative, more precise definition may consist of scoring every instance of a child directing kicks toward another individual if this is of concern. This modification aimed at precisely defining the target behavior would likely allow for more reliable measurement. Validity is also affected by the precision of the definition of a target behavior. Validity refers to data collected and conclusions drawn is representative of the behavior that was intended to be observed. Thus, if a definition is not precise, the data collected may not capture what was initially intended as the target for change.

Precise definitions have important implications in both research and clinical settings. Researchers who work with children with ASD require precise behavior definitions to ensure that their data being collected match those of later published studies. This is critical given that conclusions will be drawn from the results about the effectiveness of the intervention that is investigated during the research process. Similarly, in a clinical context, BCBAs draw conclusions on the effectiveness of an intervention for an individual with ASD based on the data they collect on the target behavior. If the definition lacks in precision, data may be collected inaccurately and likely could result in a flawed conclusion about intervention effectiveness. Given that these conclusions are used to decide if an intervention if effectively working for a child, it is vital that data collection be reliable and valid.

Types of Definitions

As noted earlier in this chapter, when defining a behavior, the type of definition must be decided on. One approach to defining behavior is topography-based, or definitions based on the form of the response rather than the function. Lequia et al. (2015) incorporated a topography-based definition aimed at improving transition behaviors of students with ASD. Specifically, they selected to included topographies of behaviors related to off-task behavior, inappropriate vocalizations, dropping to the floor, and elopement. In certain instances, a topographical definition of behavior may be paramount. For example, the topography of off-task behavior may be important to know as it would be different if the off-task behavior involves looking around the room versus constantly talking to a peer during class. While both could serve the same function to avoid classwork, the latter would be more disruptive to the class and these distinct topographies may likely influence the decision of behavior intervention. In another example, the topography of elopement could matter significantly. Suppose a child with ASD often darts away from an adult thus resulting in frequent and ongoing safety concerns. After intervention, the topography of leaving an adult topographically changes and now this child slowly walks away at a pace where an adult can easily catch up to them, thus reducing the likelihood of a safety risk.

In addition to topographically defining a behavior, behavior can also be defined in terms of function, referred to as function-based. A function-based definition consists of all responses included in a response class that serve the same function in the environment despite differences in displayed topographies. To illustrate the importance of a function-based definition, Hong et al. (2018) conducted behavior assessment on individuals diagnosed with ASD who displayed challenging behaviors and found that escape was the most common function. Observed target behaviors in

Hong et al. showed to all served the same function (escape), but were all topographically dissimilar that included self-injury, tantrums, and elopement. Hong et al. illustrate one potential function of behavior among copious other potential functions. Escaping classroom demands may be one function of a behavior, a child could also engage in a similar disruptive behavior to obtain their teacher's attention (Mueller et al., 2005), as well as to access items or activities, other social reinforcement, or even automatic reinforcement to name a few. Given the direct connection between a function-based definition and behavior intervention, it is important to understand the maintaining function of the behavior or response class. As such, function-based definitions are a critical ingredient used in behavioral assessment and intervention procedures to evaluate the effectiveness of procedures and analyze behavior change.

Measurement

Measurement is a process of assigning labels to observed phenomenon to communicate something about the phenomenon. People use measurement practices throughout their day. How much money do I have in my wallet? What is my weight this morning? How much time did it take me to complete one lap around the track? Four laps? Each of these measurement practices provides information regarding the phenomenon of interest. Additionally, different measurement practices yield different information for the same phenomenon.

For example, when running on an oval track you may measure the number of laps completed. This may be of interest because the total distance covered is of most importance. Others might be more interested in the time elapsed for each lap or the total time running, not the distance ran. Others might be interested in the number of steps taken per lap as they are working on stride length while running. Yet another dimension might be the force with which the foot makes contact with the ground and how much of that force is absorbed by the shoe versus foot.

Within the science and application of behavior analysis, behavior is the subject matter of concern (Skinner, 1953; Watson, 1913) and therefore must be measured. Of concern here is how to embark on the journey of learning about measurement of the subject matter. Many behavior analysts have previously presented measurement of behavior in similar texts (e.g., Cooper et al., 2020; Fisher et al., 2011; Johnston & Pennypacker, 2010). Comparisons of previous measurement discussions indicates differences with organization of measurement practices. For example, Cooper and colleagues approach the material from the dimensions of behavior, whereas Fisher and colleagues approach the material from a direct versus indirect measurement framework. There are also some differences in terms utilized (see "dimensional measurement," "dimensional quality," and "property" in Johnston & Pennypacker, p. 99). We acknowledge the choice of organizing the information is largely a personal preference. For the purpose of this textbook our preference is organizing measurement as dimensions of behavior. Different dimensions are presented, followed by measurement practices for those dimensions. Examples of each measurement practice are also provided.

As described in the running example above, different aspects of behavior can be measured differently to answer different questions. The measurable aspects of behavior are referred to as dimensional qualities (Cooper et al., 2020). Dimensional qualities of behavior, when measured, reflect a quantification of behavior at the specific moment of time behavior was measured. Repeated measurement of behavior is the context for behavior analysts to determine relationships between observed behavior and the surrounding world, and thereby improve the condition for the organism of interest. The dimensional qualities discussed here are repeatability, temporal extent, and temporal locus.

Repeatability

Behavior repeats across time. The runner repeatedly places one foot in front of the other over time. The number of steps taken can be counted, a starting point in the process of determining relationships between behavior (i.e., running) and environment. Counting behavior is useful when the response has a discreet beginning and end (e.g., the foot touches the ground and is then lifted off the ground). If the discrete response persists for longer periods (e.g., 30 seconds versus 5 minutes) another measurement strategy might yield better information. For example, one may count the number of words read, but measuring the duration of reading (more on this later) those words might yield better information. Lastly, counts without a recognition of the relationship to time is not as useful.

Rate is the count of behavior per unit of time. A runner may run until 5000 steps has been reached. This process of running is repeated each day. Knowing the time relationship of the daily 5000 gives further information. The runner ran for 15 minutes, 15 minutes, 20 minutes, 30 minutes, and 10 minutes respectively each day, but had the same step count. Dividing the number of steps by time yields a rate of 333.33, 250, 166.67, and 500 steps per minute across the days. Including the time component allows for comparison of the behavior between events. Similar to count, behaviors that persist for longer periods might be better measured with other measurement strategies. Additionally, rate measurement for behavior that is not freely emitted do not yield true rates. For example, Quigley et al. (2013) utilized a concurrent operant procedure to increase work completion for an elementary student. The number of times the student chose varying work tasks or break conditions were counted across sessions. Converting the choices to rates would not yield a useful comparison across sessions because the choices were only available when presented by the researcher, and the varied work or break conditions affected the number of choices available each session (e.g., five math problems compared to one problem).

Another repeatability measure is celeration, or count per unit of time, per unit of time (Calkin, 2005). The repeat of "per unit of time" is not a typo. Celeration is an extension of rate, defined as the count of behavior per unit of time. Celeration measures the change in rate across time; hence the twice repeated "per unit of time." For example, the number of correct math problems in 1 minute was two. When measured again the number of correct responses in 1 minute was four. Measured a third time, the number of correct responses was eight. The change in rate over time would be considered an X2 celeration, or the number of response is multiplying by two over time. Similarly, performance might decelerate over time. The number of self-injurious behaviors per hour across days is a behavior where deceleration is appropriate. Celeration is often displayed on a standard celeration charts (SCC), which supports standard structure and quality features of visual representation. Further treatment of celeration and SCCs are beyond the scope of this chapter, but several excellent resources already exist (e.g., Calkin; Graf & Lindsley, 2002; Kubina, 2021).

Temporal Extent

Behavior continues across time. A person runs for 30 minutes. A person plays the piano for 15 minutes. Temporal extent is the amount of time the behavior, or series of behaviors, continues. Duration is the measurement strategy that provides information about behavior continuing across time. Duration is a useful measure when the persistence of behavior needs to be extended or decreased. For example, a child who only sleeps 4 hours per day likely needs to extend the total duration of sleep per day. The duration of sleep might be measured as the total duration per day (or other time unit) or total duration per occurrence. A child might sleep at three different points during the day, where the duration of each occurrence is 2 hours, 3 hours, and 4 hours. The total sleep duration would be 9 hours within a 24 hour period, whereas the 2, 3, and 4 hours are the duration per occurrence.

Temporal Locus

Behavior occurs in relation to other events. For example, imagine you are in a car with a teenager who is late for school. You are stopped at a red traffic light and the light turns green. The amount of time that passes from the green light to you pressing the gas pedal determines whether your anxious teenager yells, “The light is green!” The amount of time between the green traffic light and the behavior of pressing the gas pedal can be measured. Latency is the measurement of time elapsed between the stimulus and behavior. Imagine another scenario with a teenager who is learning money management skills. The amount of time that elapses from receiving a weekly paycheck to purchasing a video game might be an important measure informing the success of the money management program.

Another temporal locus measurement strategy is interresponse time (IRT). The time that elapses between two instances of behavior is the IRT. May and Catrone (2021) utilized a timer and differential reinforcement of low rates of responding to decrease rapid eating for adults with Down Syndrome. Rapid eating may lead to choking and pulmonary aspiration, both health risks. Increasing the amount of time between bites (i.e., the IRT) decreases these health risks.

Derivative Measures

Derivative measures are considered to be graphical representations of data that are transformed from direct measures of dimensional qualities of behavior (see previous section). Derivative measures are often used to display data to highlight the pertinent features of the behavior of interest. Two derivative measures commonly used in science and application of behavior analysis are trials-to-criterion and percentage.

Trials-to-Criterion

Trials-to criterion is a derivative measure used to determine the number of occurrences of behavior required to reach a pre-set level of behavior performance. The parameters of the pre-set level are often determined using a normative sample and offers insight about the efficiency of interventions for the respective participant. For example, suppose that a teacher plans to compare the effectiveness of two math-based interventions on a struggling student who is struggling to recall multiplication facts, the teacher chooses to set a criterion based upon the performance of other students in the class who had already mastered the multiplication facts, and are considered to be the normative sample. The teacher is interested in the child’s multiplication fact performance (number of trials required to mastery) per math-based intervention with respect to the set criterion as determined the normative sample. The intervention that is considered to be most *efficient* is the intervention that meets the set performance criterion.

Trials-to-criterion is also suitable to capture the number of opportunities required to achieve a set criterion of a chained skill that requires several responses. For example, suppose, using a behavior chain a child is taught how to pay money to a cashier. Trials-to-criterion could be used to measure the number of trials needed for the child to independently achieve the chained skill of paying for an item. Additionally, trials-to criterion can be used to measure the number of trials needed to demonstrate independence during discrete trial instruction. To illustrate this, suppose a child is learning to identify letters using discrete trial instruction. Each presentation of a letter is likely to be displayed a set number of times (e.g., 10 times) to promote learning. The set number of times is often referred to as a *block* and the number of trials (or blocks in this case) necessary to meet the set criterion is measured using trials-to-criterion.

Percentage

Percentage, also a derivative measure, is often used to depict behavior when the behavior of interest depends on the number of opportunities presented to respond. Percentage as a derivative measure is commonly used when there is interest in the proportion of responding as it relates to a target response. For example, in discrete trial teaching the teacher may identify a target, conduct a set number of identical blocks of trials (e.g., 20 trials per block) and calculate the percentage based upon correct responding within the block. Percentage can be calculated for a range of behavior dimensions that include frequency or count, duration, and discontinuous measures. The formula used to calculate a percentage is:

$$\frac{\text{Response Occurrence}}{\text{Total Opportunities to Respond}} \times 100$$

When percentage is calculated, considerations to note include the upper and lower limit restrictions that are placed on the data. For example, drawing on the previous discrete trial instruction example, suppose that 20 trials equate to a block. The learner may accurately respond 20 out of 20 times resulting in a percentage 100%, considered the upper limit. This percentage outcome suggests that optimal learning has occurred, and that no further improvement can be made. However, if one, two, three, or more trials were conducted in addition to the initial 20 and the learner responded incorrectly, it would no longer appear that optimal learning had occurred. Rather than reflecting *true learning,* these outcomes are an artifact of the upper and lower bounds placed on the percentage derivative. These bounds, both upper and lower, can potentially distort behavior analysts' interpretation of the student's learning outcomes. Dowdy et al. (2018) included the derivative percentage to capture the success of fingernail and toenail cuts for two boys diagnosed with ASD. Percentage was selected due to the bounded number of opportunities for the finger and toenail cut behavior to occur.

Time Sampling

Various procedures exist for measuring behavior. Time sampling includes a variety of methods used to observe, record, and determine changes in behavior. Developed from ethologist studying animals in their natural environment, time sample involves dividing the observational period into equal parts and recording the presence or absence of a behavior. This method derived from an inability to observe an organism continuously (Charlesworth & Bart, 1976). Two distinct forms can be extracted from the broad method of time sampling, interval, and momentary which are commonly used in clinical and educational settings with individuals diagnosed with ASD (Powell et al., 1975). Time sampling is based upon the assumptions that in a given situation, the behavior observed at a fixed spacing in time adequately represents the presence (Bushell Jr et al., 1968). Each form provides an effective and efficient way of collecting data on behaviors.

Interval time sampling divides a session by the total time into equal parts while the observer records behaviors within the interval. The observed behavior is recorded either when the behavior occurs throughout (whole) or at any part (partial) of the interval (Cooper et al., 2020). With whole-interval recording, the observer records if the behavior occurred during the entire interval. Whole-interval recording is typically used to measure behaviors, the observer hopes to increase such as on task behavior. Figure 6.1 illustrates an example of a whole-interval sampling recording form which could be used when gathering data on a group of students. In this example, suppose the observer sets a time for 10 minutes; at the end of the 10 minutes, the observer records whether the students were on task during the entire interval by circling "yes" or "no."

Partial-interval data are collected using a similar method compared to whole-interval, yet the behavior is recorded if it occurs at any time within the interval. Partial-interval is generally used when the target behaviors occur sporadically (Kubany & Sloggett, 1973). Figure 6.2 shows an example of partial time sampling with a single client. The form is used to collect data on target behaviors, tantrum, and self-injurious behavior. The final form, momentary time sampling records whether the target behavior occurs at the moment the interval ends (Powell et al., 1975). Momentary time sampling is suitable method for a classroom teacher with copious responsibilities as it minimizes time spent on data collection (Kubany & Sloggett, 1973). To illustrate, a teacher may set a timer and mark a (T) for on task, (S) for out of seat, or (F) for off task in seat as seen in Fig. 6.3.

Time intervals	Tantrum	Self-Injurious behavior
10 minutes	Yes/No	Yes/No
20 minutes	Yes/No	Yes/No
30 minutes	Yes/No	Yes/No
40 minutes	Yes/No	Yes/No
50 minutes	Yes/No	Yes/No
60 minutes	Yes/No	Yes/No

Fig. 6.1 Partial-time sampling example

On Task			
Time intervals	**Student 1**	**Student 2**	**Student 3**
1 minute	Yes/No	Yes/No	Yes/No
2 minutes	Yes/No	Yes/No	Yes/No
3 minutes	Yes/No	Yes/No	Yes/No
4 minutes	Yes/No	Yes/No	Yes/No
5 minutes	Yes/No	Yes/No	Yes/No
6 minutes	Yes/No	Yes/No	Yes/No
7 minutes	Yes/No	Yes/No	Yes/No
8 minutes	Yes/No	Yes/No	Yes/No
9 minutes	Yes/No	Yes/No	Yes/No
10 minutes	Yes/No	Yes/No	Yes/No
11 minutes	Yes/No	Yes/No	Yes/No
12 minutes	Yes/No	Yes/No	Yes/No
13 minutes	Yes/No	Yes/No	Yes/No
14 minutes	Yes/No	Yes/No	Yes/No
15 minutes	Yes/No	Yes/No	Yes/No

Fig. 6.2 Partial-time sampling example

Permanent Product Recording

Permanent product recording measures a behavior by the impact to the environment. This measurement does not have a specific method or procedure, rather is represents the time, medium and when the observer comes in contact with the residual product. The permanent product can be naturally occurring such as a mopped floor or contrived such as a worksheet and is often used within educational, vocational, and community settings. Permanent product requires limited labor from the observer, is more accurate, and allows the opportunities for interobserver agreement and treatment integrity (Cooper et al., 2020).

Elements of Optimal Behavior Measurement

As earlier section of this chapter discussed, once the target behavior is identified and operationally defined, the researcher and practitioner are

Fig. 6.3 Momentary time sampling example

Momentary Time Sampling	
5 minutes	T S F
10 minutes	T S F
15 minutes	T S F
20 minutes	T S F
25 minutes	T S F
30 minutes	T S F
35 minutes	T S F
40 minutes	T S F
45 minutes	T S F
50 minutes	T S F
55 minutes	T S F
60 minutes	T S F
(T) for ontask , (S) out of seat (F) for off task in seat	

required to select measurement system that reflects the dimensions of the target behavior and is sensitive to changes. Then, the measurement system needs to be developed which includes who will be responsible for data collection (e.g., therapist, teachers, caregivers), when are data collected (e.g., school, home, community), and which modality will be used (e.g., paper and pencil, web-based software, video records). While developing and testing such measurement systems, there are other factors that need to be considered to optimize behavior measurement. In order to optimize the selected data collection system, it is critical to ensure that the identified measurement system encompasses its reliability, accuracy, validity, and believability.

Reliability

Data are considered *reliable* when collected data are consistent with real events. When data are reliable, the repeated measure will result in the same or similar value (Cooper et al., 2020; Johnston & Pennypacker, 2010; Kazdin, 2009). For example, when measuring the width of a table, the tape measure should yield the same value every time.

Accuracy

When data are *accurate*, observed values closely reflect what happened in real life. Accuracy of data should be considered separately from reliability (Cooper et al., 2020; Johnston & Pennypacker, 2010; Kazdin, 2009). Data collected could be reliable; however, the high reliability does not warrant its accuracy. For instance, the scale might yield the same weight every time you use the scale (*reliable*); however, if the scale is broken or not calibrated, the weight will not be accurate.

Validity

Validity concerns whether or not the chosen measurement reflects the value of what you plan to study. Johnston and Pennypacker (2010) pointed out the issues of indirect measurement in social science. When the instrument involves indirect measurement (e.g., survey), the results must be inferred from the measurement (Johnston & Pennypacker, 2010).

Believability

When data and measurement systems are not desirable, the practitioner or researcher should ask whether data are worthy of demonstrating the relationship between the independent variable and dependent variable. Rather than describing the relationship between what actually happened and observed data that approximate or represent, the believability is how collected data are convincing to be "good enough" to be interpreted (Johnston & Pennypacker, 2010).

Challenges (Artifact and Bias)

Although it is critical to collect accurate, reliable, and valid data to monitor progress, the efficacy of the intervention, and the fidelity of program implementation, there are many challenges that need to be considered. Data can be affected by many sources of variables, including observer drift, reactivity, the complexity of the measurement system, and observers' expectations (Kazdin, 1977).

Observer Drift

When observers are trained to collect data, they initially adhere to the definition of the particular behavior of interest closely. However, even after the observers consistently meet the mastery criterion with a high percentage of agreement, they might start to collect data that deviated from the original definition over time. This is called *observer drift*. Kazdin (1977, 2011) pointed out the difficulties in identifying observer drift. The interobserver agreement (IOA), the agreement among independent observers, may remain high while the accuracy declines, especially when observers work closely together for the particular learner or project.

Reactivity

As many environmental variables affect the behavior of interest, the presence of an observer may influence the learner's behavior. The learner might not exhibit the behaviors of concern simply a novel person is in a classroom. In addition, the behavior of the observer may be affected by the presence of an additional observer for a reliability check. The observer might adhere to the procedures to collect data more closely compared to in the absence of another observer. This phenomenon is called *reactivity* (Kazdin, 2009, 2011).

Expectation

The knowledge of researchers' intent might affect the observer's data collection. When the observer expects the impact of the intervention, it is possible that the observer scores differently during the intervention compared to the baseline condition. However, Kazdin (1977) noted that expectation alone would not affect the data collection but rather it with feedback would affect the observer.

Strategies to Overcome Challenges

Observer Drift

Observer drift can be addressed in a few different ways. First, providing ongoing training would minimize the observer drift. The training could include reviewing definitions periodically, observing and providing feedback during direct supervision, and discussing the definition among observers. Second, introducing the additional observer who is newly trained for the team and collecting IOA would not only minimize observer drift but also help identify the need for additional training for existing observers. Additionally, making the definition readily available with data collection methods and making the observer read the definition prior to collecting data could minimize observer drift. For example, the definition can be added to the datasheet for easy reference.

Reactivity

There are a few ways to address reactivity. Implementing unobtrusive observation methods would prevent the reactivity of learners and observers. For instance, videotaping sessions to assess IOA will minimize reactivity since the observer is unaware of being observed. Similarly, videotaping or using an observation room with a two-way mirror would also reduce the reactivity of the learner.

Expectation

Although it is difficult to prevent expectation of the observer in single subject designs since the changes in conditions are often apparent (e.g., the presence or absence of interventions), the expectation by itself might not influence data without being followed by feedback. Minimizing feedback to observers related to the study's outcomes would be necessary. Further, Kazdin (2011) suggested that collecting data in random order of videotaped segments would support minimizing bias associated with the observer's expectation.

Other Considerations

Researchers and practitioners should consider several factors that might affect the accuracy and reliability of the measurement while setting up a measurement system. The first factor is the ease of measurement. When the measurement system is complex, it more likely affects the accuracy and reliability of data. The observer might miss the behavior while navigating the complex measurement system. If the system is visually distracting, the observer might record the behavior inaccurately. Thus, the system should be simple and streamlined without distracting features to prevent such errors. The second factor is the nature of the target behavior. When the behavior of interest is a challenging behavior that poses a safety risk to the individual or others, the observer as an instructor needs to address safety concerns first. The materials for the selected measurement system might increase such risk (e.g., throwing a tablet, using a pencil to harm others). This could become a barrier in recording behavior. Simplifying the measurement system and removing obstacles to access and navigate such a system, along with addressing safety concerns of its materials, are critical for accurate and reliable data, especially in practices. In addition, when designing the measurement system, materials should be readily available for the observer to record the behavior of interest when the observer is also working as an instructor. Considering these factors, the researcher and practitioner should develop the best possible measuring system that reflects the behavior.

Interobserver Agreement (IOA)

Interobserver agreement (IOA) is used to assess the accuracy of data collected through at least two independent observers collecting data and calculating the agreement among observers. However, it is pointed out that the relationship between accuracy and the actual phenomenon is inferred with IOA. Johnston and Pennypacker (2010) state that the complete agreement among independent observers does not necessarily reflect what actually happened. Thus, it does not guarantee the accuracy of collected data.

In addition, IOA is used to assess the reliability of data. However, it is also questioned whether IOA reflects the reliability of data (Kostewicz et al., 2016) since additional observers do not measure the consistency of data collection by a single observer (Boyce et al., 2000).

Reliability of Data

As covered earlier in this chapter, reliability is defined as the consistency of repeated data by a single observer. Despite concerns on assessing reliability (Boyce et al., 2000; Johnston & Pennypacker, 2010; Kostewicz et al., 2016), reliability is a critical dimension of dependent measures. Behavior analysis as a science of behavior should encompass three levels of understanding that are description, prediction, and control (Cooper et al., 2020). First, the phenomenon under study should be operationally defined. This is the first step to understanding and quantifying the dependent variable (e.g., behavior) of interest. Second, when the repeated observation demonstrates the pattern of the dependent variable, it is predicted that the pattern will continue in the same condition. Third, when the manipulation of the independent variable (e.g., intervention) can reliably change the dependent variable (e.g., behavior) rather than by other variables, the control of the independent variable on the dependent variable (functional relationship between IV and DV) is demonstrated.

Although there are concerns on what IOA exactly assesses, it is critical to measure agreement among observers. Kazdin (1977) identified three reasons for such measurement, (1) assessing the consistency of data beyond normal fluctuation of performance, (2) identifying observer biases, and (3) detecting incomprehensive definition. Additionally, the inconsistent agreement can detect the inadequacy of the measurement system. As noted earlier, if the measurement system is hard to navigate, the reliability and accuracy of data would be at risk.

Types of IOA

There are several variations of interobserver agreement (IOA), the percentage of agreement/disagreement based on the measurement system. In general, they can be separated into three categories: (1) event-based, (2) duration-based, and (3) interval-based (Cooper et al., 2020; Johnston & Pennypacker, 2010; Read & Azulay, 2011).

Total Count IOA

When the observers use "count" as a measurement, Total Count IOA can be used.

The formula of Total Count Agreement is:

$$\frac{\text{The smaller count}}{\text{The larger count}} \times 100$$

For example, when the first observer recorded 14 aggression and the second observer recorded 18 aggressions, the percentage of agreement is calculated as below.

$$\frac{\text{The smaller count}}{\text{The larger count}} \times 100$$

$$14/18 \times 100 = 77.8\% \text{ agreement}$$

A disadvantage of using this procedure is that the result might not reflect agreement or disagreement of a particular instance of the target response. In the example below, the total count for observer 1 and observer 2 are both 4. Total Count IOA is calculated as:

$$4/4 \times 100 = 100\% \text{ agreement}$$

However, the observers are recording different instances of the response. Thus, this is not the most rigorous procedure to calculate IOA, and researchers or practitioners should take this into consideration for choosing this type of IOA (Table 6.1).

Exact Count IOA

When the observers use "count" as a measurement and the researcher or practitioner is concerned more than just the agreement of the total number of responses, Exact Count IOA can be used. Since this procedure looks for agreement per interval, this method produces the conservative value of agreements. This measurement begins with setting up intervals (e.g., 5 minutes) to collect data. After both observers collected data, it is assessed whether or not the count for each interval matches. The formula to calculate Exact Count IOA is:

Table 6.1 This table is the sample IOA data collected by two independent observers

Intervals	Observer 1	Observer 2	Agreement
1	1	1	Yes
2	3	2	No
3	0	0	Yes
4	0	1	No
5	0	0	Yes
Total	4	4	

$$\frac{\text{The number of agreed intervals}}{(\text{The number of agreed intervals} + \text{The number of disagreed intervals})} \times 100 = \text{Exact Count IOA}$$

Table 6.2 shows data collected by both observers and agreement for each interval.

In this example, data for three intervals match out of five intervals. This results in 60% agreement.

$$\frac{\text{The number of agreed intervals}}{(\text{The number of agreed intervals} + \text{The number of disagreed intervals})} \times 100$$
$$3/(3+2) \times 100 = 60\%$$

Mean Count per Interval (Partial Agreement-Within-Intervals) IOA

In addition to identifying the agreement, whether they match or not, per interval, Mean Count per Interval IOA (aka Partial Agreement-Within Interval IOA) includes the agreement of numeric value for each interval. Similar to the Exact Count IOA, the observation period will be broken down into equal intervals (e.g., 5 minutes). In this IOA, the percentage is calculated per interval first. Then the mean percentage will be calculated by dividing the sum of interval IOA by the number of intervals (Table 6.3).

$$\frac{(\text{Interval 1 IOA} + \text{Interval 2 IOA} \ldots)}{\text{The number of Interval}} \times 100 = \text{Mean Count per Interval IOA}$$

$$\frac{(\text{Interval 1 IOA} + \text{Interval 2 IOA} \ldots)}{\text{The number of Interval}} \times 100$$
$$(100 + 66.7 + 50 + 50 + 0)/5 = 53.34\%$$

This procedure increases the accuracy of agreement by calculating the agreement per interval and reducing the chance of false agreement which is probable in Total Count IOA.

Trial-by-Trial

In Trial-by-Trial IOA, two or more independent observers will collect data for each trial. This procedure encompasses trial-based responses (e.g., discreate trial instructions) rather than free operant condition. The formula to calculate the percentage of IOA is:

$$\frac{\text{The number of agreed trials}}{(\text{The number of agreed trials} + \text{the number of disagreed trials})} \times 100 = \text{Trial by Trial IOA}$$

Table 6.2 This table represents the sample IOA data summary collected by two independent observers

Intervals	Observer 1	Observer 2	Agreement
1	1	1	Yes
2	3	2	No
3	0	0	Yes
4	0	1	No
5	0	0	Yes

Table 6.3 This table represents the sample IOA data collected by two independent observers

Intervals	Observer 1	Observer 2	IOA
1	1	1	1 ÷ 1 × 100 = 100%
2	3	2	2 ÷ 3 × 100 = 66.7%
3	2	4	2 ÷ 4 × 100 = 50%
4	2	1	1 ÷ 2 × 100 = 50%
5	0	1	0 ÷ 1 × 100 = 0%

Table 6.4 shows trial data collected by two independent observers.

In this example, data for four trials match out of five trials. This results in 80% agreement.

$$\frac{\text{The number of agreed trials}}{(\text{The number of agreed trials} + \text{the number disagreed trials})} \times 100$$
$$4/(4+1)\times 100 = 80\%\text{Trial by Trial IOA}$$

Total Duration IOA

When the observers use "duration" as a measurement, and the researcher or practitioner is concerned about the total duration of responses, Total Duration IOA can be used. The formula of Total Duration IOA is:

$$\frac{\text{The shorter duration}}{\text{The longer duration}} \times 100 = \text{Total Duration IOA}$$

For example, when the first observer recorded 15 total minutes of tantrum and the second observer recorded 20 total minutes of tantrum, the percentage of agreement is calculated as below.

$$\frac{\text{The shorter duration}}{\text{The longer duration}} \times 100 = \text{Total Duration IOA}$$
$$15/20\times 100 = 75\%$$

Similar to the total count IOA, the disadvantage of this IOA is that the high percentage of agreement does not guarantee the same instances are recorded.

Mean Duration per Occurrence IOA

When observers are collecting duration per occurrence, they will calculate the average duration per occurrence. In addition to identifying the agreement of total duration, Mean Duration per Occurrence IOA takes the agreement of numeric value for each occurrence. In this IOA, the percentage is calculated per response first. Then, the mean percentage will be calculated by dividing the sum of Response IOA by the number of responses (Table 6.5).

Table 6.4 This table represents the sample interval-based IOA data collected by two independent observers

Trials	Observer 1	Observer 2	Agreement
1	–	–	Yes
2	+	+	Yes
3	–	+	No
4	+	+	Yes
5	+	+	Yes

Table 6.5 This table represents the sample duration based IOA data collected by two independent observers

Responses	Observer 1	Observer 2	IOA
1	22.21	24.02	22.21 ÷ 24.02 × 100 = 92.46%
2	15.52	13.75	13.75 ÷ 15.52 × 100 = 88.60%
3	10.54	8.22	8.22 ÷ 10.54 × 100 = 77.99%
4	18.42	19.21	18.42 ÷ 19.21 × 100 = 95.89%
5	17.02	17.78	17.02 ÷ 17.78 × 100 = 95.73%

$$\frac{(\text{Response 1 IOA} + \text{Response 2 IOA}\ldots)}{\text{The number of responses}} \times 100 = \text{Mean Duration per Occurrence IOA}$$

$$(92.46 + 88.6 + 77.99 + 95.89 + 95.73)/5 \times 100 = 90.13\%$$

The advantage of the Mean Duration per Occurrence IOA is that the measurement takes instances of response into consideration and is a more conservative way to address agreement compared to Total Duration IOA.

Interval-by-Interval IOA

Interval-by-Interval IOA assess agreement on interval-based data (e.g., partial interval, whole interval, momentary time sample) collected by two or more observers. The formula for Interval-by-Interval IOA is (Table 6.6):

$$\frac{\text{The number of intervals with agreement}}{(\text{The number of intervals with agreement} + \text{the number of disagreement})} \times 100 = \text{Interval} - \text{by} - \text{Interval IOA}$$

In the sample data, two observers agreed on 4 intervals out of 5 total intervals.

$$\frac{\text{The number of intervals with agreement}}{(\text{The number of intervals with agreement} + \text{the number of disagreement})} \times 100$$

$$4/(4+1) \times 100 = 80\%$$

The disadvantage of this procedure is that the percentage might be inflated, especially with partial interval recordings, since they are discontinuous measurements and tend to overestimate.

Scored-Interval IOA (Occurrence IOA)

To address the disadvantage of Interval-by-Interval IOA, Occurrence IOA restricts the criterion of agreement on only scored intervals. The formula of Occurrence IOA is (Table 6.7):

$$\frac{\text{The number of Scored Interval with Agreement}}{(\text{The number of Scored Interval with Agreement} + \text{The number of Scored Interval w/o Agreement})} \times 100$$

Table 6.6 This table represents sample data collected by two observers. +: occurrence of the response, –: non-occurrence of the response

Trials	Observer 1	Observer 2	Agreement
1	–	–	Yes
2	+	+	Yes
3	–	+	No
4	+	+	Yes
5	+	+	Yes

Table 6.7 This table represents the sample interval-based IOA data collected by two independent observers

Trials	Observer 1	Observer 2	Agreement
1	–	–	–
2	+	+	Yes
3	–	+	No
4	+	+	Yes
5	–	–	–

In above sample data, the target response was observed during interval 2, interval 3, and interval 4. Within these three intervals, both observers recorded the response in interval 2 and 4 out of three recorded intervals.

$$2/(2+1)\times 100 = 66.7\%$$

This measure is recommended for the low-rate responses to avoid inflation of the percentage of agreement.

Unscored-Interval IOA (Non-occurrence IOA)

For the same reason, addressing the disadvantage of Interval-by-Interval IOA, Unscored-Interval IOA applies restriction on the criterion of the agreement for unscored intervals (Table 6.8).

$$\frac{\text{The number of Unscored Interval with Agreement}}{\left(\text{The number of Unscored Interval with Agreement}+\text{The number of Unscored Interval w/o Agreement}\right)}\times 100$$

In the sample data above, the target response was not observed during interval 1, interval 3, and interval 5. Within these three intervals, both observers recorded the non-response in interval 1 and 5 out of three recorded intervals.

$$2/(2+1)\times 100 = 66.7\%$$

For the high-rated responses, Unscored-Interval IOA is a more conservative measure, so the percentage of the agreement would not be inflated.

Acceptable Levels

Although there is no scientifically supported acceptable level of IOA (Kennedy, 2005), the conventionally acceptable level of IOA is 80% or higher Cooper et al., 2020; Johnston & Pennypacker, 2010). The high percentage of IOA supports the believability of data; however, as noted above, under 80% of agreement might be acceptable with the complexity of the environment (Cooper et al., 2020).

How Often Should It Be Collected?

In general, the minimally acceptable percentage of data for IOA is 20% of study data (Cooper et al., 2020; Gast, 2009; Kazdin, 2011; Ledford & Gast, 2018). These data should be collected across all conditions, settings, times, days of the week to increase the believability of the data. To be conservative, Cooper et al. (2020) suggest assessing IOA more frequently at the beginning of the study, which can be tapered off toward the end of the study.

How Should IOA Be Reported?

It is acceptable to report IOA scores in various formats, including narrative texts, tables, and plotting within graphs (Cooper et al., 2020; Kazdin, 2011). For example, Nepo et al. (2021) reported interval-by-interval IOA per dependent variable with ranges (96.5%, range = 86–100% for task completion, 99.7%, range = 93.3–100% for schedule following, and 98.8%, range = 91.3–100% for duration) and the percent of sessions data were collected (28% for experiment 1 and 32.3% for experiment 2). Additionally, the authors calculated interval-by-interval IOA for fidelity check with ranges (98.9%, range = 87.5–

Table 6.8 This table represents the sample interval-based IOA data collected by two independent observers

Trials	Observer 1	Observer 2	Agreement
1	–	–	Yes
2	+	+	–
3	–	+	No
4	+	+	–
5	–	–	Yes

Table 6.9 Summary of IOA (Boyd et al., 2007)

From: *Effects of Circumscribed Interests on the Social Behaviors of Children with Autism Spectrum Disorders*					
Preference assessment	Structural analysis				
	Choice condition	Alternating treatment condition			
Duration of engagement	% of intervals	% of social interaction		Rate of initiations	
Mean	Mean	Mean	Range	Mean	Range
100	100	100	100	100	100
100	100	98	97–100	83	67–100
100	100	98	95–100	83	67–100

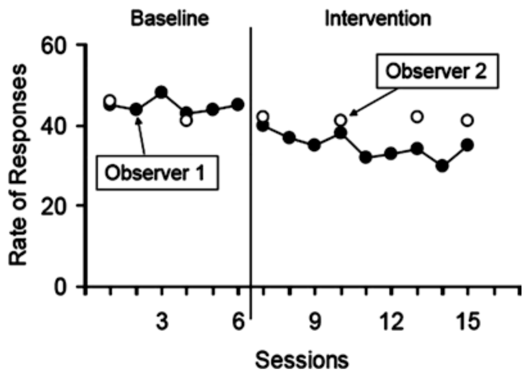

Fig. 6.4 Hypothetical data of two observers plotted in a graph (Artman et al., 2012)

100% for experiment 1 and 100% for experiment 2), and the percentage of sessions data were collected (28% and 322.3%, respectively).

Boyd et al. (2007) included a table to summarize IOA in their study in which they compared circumscribed interests (CI) and less preferred items on social responses of three children with ASD (Table 6.9).

Although it is uncommon (Artman et al., 2012), it is also acceptable to display the second observer's data in the same graph (Tertinger et al., 1984; Van Houten & Rolider, 1984) (Fig. 6.4).

Applications

Total Count IOA

Alter et al. (2008) investigated the consistency of the results from direct and indirect functional behavior assessment (FBA) with analog Functional Analysis (FA). Total count IOA was used for FBA data as well as FA data. Data were collected for 38% of intervals (15 minutes) for FBA and 39% of sessions for FA. The authors reported the agreement of each participant separately for FBA and FA with ranges (e.g., Participant 1: 97%, range, 90–100%, Participant 2: 96%, range, 83–100%, and Participant 3: 87%, range, 60–100%).

Mean Count per Interval IOA

Boyle et al. (2019) evaluated the impact of functional communication training on a child with reported maladaptive behavior. The authors reported the mean count-per-interval IOA 30% of intervention sessions for function-based responses with ranges (e.g., tangible communicative response: 100%, escape communicative response, M = 99%, range, 93–100%). In addition, scored interval IOA was reported for functional analysis phase with the range (e.g., 92%, range, 75–100%).

Exact Count IOA

Exact count per interval IOA was used in the study to assess the impact of a peer network social group on social communication of children with autism spectrum disorder (ASD) (Kamps et al., 2014). IOA was collected for 20% of sessions by an independent trained observer and was calculated for the agreement of 5-second intervals in 10-minute observations. The authors reported the average percent of agreement with range for each communicative response across conditions with the range as well as overall agreement (e.g., baseline: 72–98%, intervention: 67–97%, overall: 86.9%).

Trial-by-Trial

Ciccone et al. (2007) examined the stability of preference with Multiple Stimulus without Replacement (MSWO) for adolescents who live in residential programs. In this study, trial-by-trial IOA is used to assess agreement between two observers. The authors reported the percentage of IOA, above 98%, that were collected for 39.3% (experiment 1) and 53.6% (experiment 2) of sessions.

Total Duration

Delemere and Dounavi (2018) addressed sleep issues of six children with ASD by training parents to implement bedtime fading procedures (Morgenthaler et al., 2007). In this study, latency, duration and frequency of night waking, and sleep duration data were collected. Participants' parents collected data independently, and total duration IOA was calculated. The author reported the percentage of total duration IOA (100%) as well as mean IOA with ranges for each dependent variable.

Mean Duration per Occurrence IOA

Rose and Beaulieu (2019) replicated and extended the study by Hanley et al. (2014) by assessing the efficacy of intervention derived from interview-based functional analysis for two children with ASD. Mean Duration per Occurrence IOA was calculated from data for play engagement collected by two independent observers 30% of all sessions. Additionally, the mean count per interval IOA was used for other variables such as functional communication responses. The authors reported the overall percentage of IOA with a range per participant.

Interval-by-Interval IOA

Neely et al. (2013) compared instructional modalities, iPad-based versus traditional presentation, on escape-maintained challenging behaviors for two children with developmental disabilities. In this study, the independent observer collected IOA 40% of sessions across phases. Interval-by-interval IOA was calculated, and the authors reported mean IOAs with ranges for challenging behavior and academic engagement per participant and per dependent variable (Dan: 100%, Elton: 99%, range 90–100%).

Scored Interval IOA

Allen et al. (2010) investigated the impact of video modeling on the vocational skills of four adolescents with ASD. Data on vocational skills, customer engagement as a costumed character, such as shaking hands, wagging tail, or wiggling ears with a partial interval recording (15-second interval). Scored interval IOA was calculated for 35% of sessions across phases, and the authors reported the percentage of agreement with range for each participant.

Non-Scored Interval IOA

Neely et al. (2020) examined the efficacy of functional communication training in instructional language on communicative response in instructional language, and maladaptive behaviors of three children with ASD whose primary language at home was Spanish. The second independent observer collected data on dependent variables for 30% of sessions, and interval-by-interval IOA was calculated for scored and non-scored IOA. The authors reported the average IOA as well as its range for each participant.

Reporting IOA in behavior analytic research is now a common practice to assess believability as well as inferred accuracy and reliability of data. Further, as noted earlier, collecting and calculating IOA to assess the completeness of definition, ease of implementing the selected measurement system, biases, and other barriers is beneficial in practices. The researcher or practitioner should choose the measurement system carefully to obtain meaningful data and continue to assess the measurement system.

Conclusion

To support those in or entering the field of applied behavior analysis, as well as current and future researchers and clinicians in related disciplines, this chapter describes the basic principles underlying observation and measurement of behaviors of children with ASD. The essential elements of defining target behaviors are then discussed as the starting point for all behavioral observations. The chapter also includes a discussion of the importance of these definitions being precise from the perspective of both clinicians and researchers working with children with ASD followed by an overview and examples of the types of behavioral definitions (topography-based versus function-based).

The chapter also focuses on the role of measurement in behavioral observations. Specifically, measurable dimensions as well as how to select appropriate measurable dimensions for the specific case/behavior are discussed. An overview and examples of derivative measures, as well as time sampling procedures, are also included in this chapter. The chapter also provides an exploration of the essential elements of optimal behavior measurement, as well as the challenges that may arise. Furthermore, interobserver agreement is discussed in this chapter along with a discussion of the benefits and its application when two or more observers are available for behavioral observation. Taken together, the elements discussed in this chapter serve as underlying ingredients for effective assessment and function-based intervention rooted in applied behavior analysis to support the lives of individuals diagnosed with ASD.

References

Ahearn, W. H., & Tiger, J. H. (2013). Behavioral approaches to the treatment of autism.

Allen, K. D., Wallace, D. P., Renes, D., Bowen, S. L., & Burke, R. V. (2010). Use of video modeling to teach vocational skills to adolescents and young adults with autism spectrum disorders. *Education and Treatment of Children, 33*(3), 339–349.

Alter, P. J., Conroy, M. A., Mancil, G. R., & Haydon, T. (2008). A comparison of functional behavior assessment methodologies with young children: Descriptive methods and functional analysis. *Journal of Behavioral Education, 17*(2), 200–219.

Artman, K., Wolery, M., & Yoder, P. (2012). Embracing our visual inspection and analysis tradition: Graphing interobserver agreement data. *Remedial and Special Education, 33*(2), 71–77. https://doi.org/10.1177/0741932510381653

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91.

Bosch, S., & Fuqua, R. W. (2001). Behavioral cusps: A model for selecting target behaviors. *Journal of Applied Behavior Analysis, 34*(1), 123–125. https://doi.org/10.1901/jaba.2001.34-123

Boyd, B. A., Conroy, M. A., Mancil, G. R., Nakao, T., & Alter, P. J. (2007). Effects of circumscribed interests on the social behaviors of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*(8), 1550–1561.

Boyle, M. A., Stamper, S. M., Donaldson, E. A., Curtis, K. S., Forck, K. L., Shrimplin, M. A., et al. (2019). Functional communication training for multiple reinforcers: An evaluation of isolated control following a synthesized context. *Behavior Analysis in Practice, 12*(3), 592–599.

Boyce, T. E., Carter, N., & Neboschick, H. (2000). An evaluation of intraobserver reliability versus interobserver agreement. *European Journal of Behavior Analysis, 1*, 107–114. https://doi.org/10.1080/15021149.2000.11434159

Bushell, D., Jr., Wrobel, P. A., & Michaelis, M. L. (1968). Applying "grouf" contingencies to the classroom study behavior of preschool children. *Journal of Applied Behavior Analysis, 1*(1), 55–61.

Calkin, A. B. (2005). Precision teaching: The standard celeration charts. *The Behavior Analyst Today, 6*(4), 207–215.

Charlesworth, W. C., & Bart, W. M. (1976). Some contributions of ethology for education. *Educational Studies, 7*(3), 258–272.

Ciccone, F. J., Graff, R. B., & Ahearn, W. H. (2007). Long-term stability of edible preferences in individuals with developmental disabilities. *Behavioral Interventions, 22*(3), 223–228.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis*. Pearson UK.

Delemere, E., & Dounavi, K. (2018). Parent-implemented bedtime fading and positive routines for children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 48*(4), 1002–1019.

Dowdy, A., Tincani, M., Nipe, T., & Weiss, M. J. (2018). Effects of reinforcement without extinction on increasing compliance with nail cutting: A systematic replication. *Journal of Applied Behavior Analysis, 51*(4), 924–930. https://doi.org/10.1002/jaba.484

DSM-5 American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.).

Eldevik, S., Jahr, E., Eikeseth, S., Hastings, R. P., & Hughes, C. J. (2010). Cognitive and adaptive behavior outcomes of behavioral intervention for young children with intellectual disability. *Behavior Modification, 34*(1), 16–34.

Fisher, W. W., Piazza, C. C., & Roane, H. S. (Eds.). (2011). *Handbook of applied behavior analysis*. The Guilford Press.

Gast, D. L. (2009). *Single subject research methodology in behavioral sciences: Applications in special education and behavioral sciences*. Routledge.

Graf, S. A., & Lindsley, O. R. (2002). *Standard celeration charing 2002*. Graf Implements.

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analysis and treatments. *Journal of Applied Behavior Analysis, 47*, 16–36. https://doi.org/10.1002/jaba.106

Hong, E., Dixon, D. R., Stevens, E., Burns, C. O., & Linstead, E. (2018). Topography and function of challenging behaviors in individuals with autism spectrum disorder. *Advances in Neurodevelopmental Disorders, 2*(2), 206–215. https://doi.org/10.1007/s41252-018-0063-7

Jick, H., & Kaye, J. A. (2003). Epidemiology and possible causes of autism. *Pharmacotherapy, 23*(12), 1524– 1530. https://doi.org/10.1592/phco.23.15.1524.31955

Johnston, J. M., & Pennypacker, H. S. (2010). *Strategies and tactics of behavioral research*. Routledge.

Kazdin, A. E. (1977). Artifact, bias, and complexity of assessment: The ABCs of reliability. *Journal of Applied Behavior Analysis, 10*, 141–150. https://doi.org/10.1901/jaba.1977.10-141

Kazdin, A. E. (2009). Psychological Science's contributions to a sustainable environment: Extending our reach to a grand challenge of society. *American Psychologist, 64*, 339–356. http://dx.doi.org/10.1037/a0015685

Kazdin, A. E. (2011). Single-Case Research Designs, Second Edition. New York, NY: Oxford University Press, xi + 452 pp., $72.95.

Kennedy, C. H. (2005). *Single-case designs for educational research*. Allyn and Bacon.

Kamps, D., Mason, R., Thiemann-Bourque, K., Feldmiller, S., Turcotte, A., & Miller, T. (2014). The use of peer networks to increase communicative acts of students with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 29*(4), 230–245.

Kostewicz, D. E., King, S. A., Datchuk, S. M., Brennan, K. M., & Casey, S. D. (2016). Data collection and measurement assessment in behavioral research: 1958–2013. *Behavior Analysis: Research and Practice, 16*(1), 19.

Kubany, E. S., & Sloggett, B. B. (1973). Coding procedure for teachers. *Journal of Applied Behavior Analysis, 6*(2), 339–344.

Kubina, R. M. (2021). Precision teaching and behavior dynamics. *Behavior Analysis in Practice, 14*, 577–581. https://doi.org/10.1007/s40617-020-00482-3

Kuhn, M., Marvin, C. A., & Knoche, L. L. (2017). In it for the long haul: Parent–teacher partnerships for addressing preschool children's challenging behaviors. *Topics in Early Childhood Special Education, 37*(2), 81–93. https://doi.org/10.1177/0271121416659053

Landrigan, P. J., Lambertini, L., & Birnbaum, L. S. (2012). A research strategy to discover the environmental causes of autism and neurodevelopmental disabilities. *Environmental Health Perspectives, 120*(7), a258-a260.

Ledford, J. R., & Gast, D. L. (Eds.). (2018). *Single case research methodology*. Routledge.

Lequia, J., Wilkerson, K. L., Kim, S., & Lyons, G. L. (2015). Improving transition behaviors in students with autism spectrum disorders: A comprehensive evaluation of interventions in educational settings. *Journal of Positive Behavior Interventions, 17*(3), 146–158. https://doi.org/10.1177/1098300714548799

Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, et al. (2021). Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2018. Morbidity and mortality weekly report. Surveillance summaries (Washington, D.C. : 2002), *70*(11), 1–16. https://doi.org/10.15585/mmwr.ss7011a1

Martens, B. K., Hiralall, A. S., & Bradley, T. A. (1997). A note to teacher: Improving student behavior through goal setting and feedback. *School Psychology Quarterly, 12*(1), 33–41. https://doi.org/10.1037/h0088945

Matson, J. L., & Kozlowski, A. M. (2011). The increasing prevalence of autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(1), 418–425.

May, B. K., & Catrone, R. (2021). Reducing rapid eating in adults with Down Syndrome: Using token reinforcement to increase interresponse times between bites. *Behavior Analysis: Research and Practice, 21*(2), 273–281. https://doi.org/10.1037/bar0000213

Morgenthaler, T. I., Lee-Chiong, T., Alessi, C., Friedman, L., Aurora, R. N., Boehlecke, B., et al. (2007). Practice parameters for the clinical evaluation and treatment of circadian rhythm sleep disorders. *Sleep, 30*(11), 1445–1459.

Morris, E. K., Smith, N. G., & Altus, D. E. (2005). BF Skinner's contributions to applied behavior analysis. *The Behavior Analyst, 28*, 99–131.

Mueller, M. M., Sterling-Turner, H. E., & Moore, J. W. (2005). Towards developing a classroom-based functional analysis condition to assess escape-to-attention as a variable maintaining problem behavior. *School Psychology Review, 34*(3), 425–431. https://doi.org/10.1080/02796015.2005.12086296

Neely, L., Graber, J., Kunnavatana, S., & Cantrell, K. (2020). Impact of language on behavior treatment outcomes. *Journal of Applied Behavior Analysis, 53*(2), 796–810.

Neely, L., Rispoli, M., Camargo, S., Davis, H., & Boles, M. (2013). The effect of instructional use of an iPad® on challenging behavior and academic engagement for two students with autism. *Research in Autism Spectrum Disorders, 7*(4), 509–516.

Nepo, K., Tincani, M., & Axelrod, S. (2021). Teaching mobile device-based leisure to adults with autism spectrum disorder and intellectual disability. *Focus on Autism and Other*

Developmental Disabilities, 36(2), 83–94. https://doi.org/10.1177/1088357620943500

Powell, J., Martindale, A., & Kulp, S. (1975). An evaluation of time-sample measures of behavior. *Journal of Applied Behavior Analysis, 8*(4), 463–469.

Quigley, S. P., Peterson, S. M., Frieder, J. E., Mullins, S., Brower-Breitwieser, C., Ivers, H., & Ackers, N. (2013). Assessing passive noncompliance in a student with an autism spectrum disorder within a concurrent operant paradigm. *Journal of Evidence-based Practices for Schools, 14*, 81–102.

Reed, D. D., & Azulay, R. L. (2011). A Microsoft Excel® 2010 based tool for calculating interobserver agreement. *Behavior Analysis in Practice, 4*(2), 45–52.

Ronald, A., & Hoekstra, R. A. (2011). Autism spectrum disorders and autistic traits: a decade of new twin studies. *American Journal of Medical Genetics Part B: Neuropsychiatric Genetics, 156*(3), 255–274.

Rosales-Ruiz, J., & Baer, D. M. (1997). Behavioral cusps: A developmental and pragmatic concept for behavior analysis. *Journal of Applied Behavior Analysis, 30*(3), 533–544. https://doi.org/10.1901/jaba.1997.30-533

Rose, J. C., & Beaulieu, L. (2019). Assessing the generality and durability of interview-informed functional analyses and treatment. *Journal of Applied Behavior Analysis, 52*(1), 271–285.

Skinner, B. F. (1938). 1966. *The Behavior of organisms*.

Skinner, B. F. (1953). *Science and human behavior*. The Free Press.

Tertinger, D. A., Greene, B. F., & Lutzker, J. R. (1984). Home safety: Development and validation of one component of an ecobehavioral treatment program for abused and neglected children. *Journal of Applied Behavior Analysis, 17*(2), 159–174.

Timothy, W. Y., Chahrour, M. H., Coulter, M. E., Jiralerspong, S., Okamura-Ikeda, K., Ataman, B., ... & Walsh, C. A. (2013). Using whole-exome sequencing to identify inherited causes of autism. *Neuron, 77*(2), 259–273.

Van Houten, R. (1979). Social validation: The evolution of standards of competency for target behaviors. *Journal of Applied Behavior Analysis, 12*(4), 581–591. https://doi.org/10.1901/jaba.1979.12-581

Van Houten, R., & Rolider, A. (1984). The use of response prevention to eliminate nocturnal thumbsucking. *Journal of Applied Behavior Analysis, 17*(4), 509–520.

Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review, 20*(2), 158–177. https://doi.org/10.1037/h0074428

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart 1. *Journal of Applied Behavior Analysis, 11*(2), 203–214. https://doi.org/10.1901/jaba.1978.11-203

7 Choice and Preference Assessments

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Reinforcement-based procedures are the cornerstone of applied behavior analysis and critical to replacing interfering or challenging behavior and learning new skills (Fisher et al., 1996; Hanley et al., 2003; Karsten & Carr, 2009). Licensed and board certified behavior analysts (BCBA) are charged with identifying stimuli and events that when incorporated strategically into programming efforts (i.e., delivered contingent on target behavior or noncontingently) will function as reinforcers and produce meaningful behavior change. Reinforcers, however, are idiosyncratic and individuals with limited verbal skills cannot tell others what will reinforce their behavior. Fortunately, a robust technology using empirically derived choice arrangements has been developed to assess preferences for stimuli or events (e.g., DeLeon & Iwata, 1996; Fisher et al., 1992; Hanley et al. 2003; Pace et al., 1985; Roane et al., 1998). Choice responses across iterations show relative preference (Fisher & Mazur, 1997), and relative preference measures correspond with reinforcer efficacy in that more preferred stimuli are more efficacious reinforcers than less preferred stimuli (Piazza et al., 1996).

Providing choice opportunities and measuring preferences are important practices for behavior analysts. Acknowledging the importance of clients' choices and fostering self-determination are integrated into the Behavior Analyst Certification Board (2020) Ethics Code for Behavior Analysts and conducting preference assessments and incorporating preferences into clients' treatment goals and strategies are included in the Behavior Analyst Certification Board (2017) BCBA Task List (5th edition) and the Behavior Analyst Certification Board (2022) BCBA Test Content Outline (6th edition).

This chapter reviews choice contingencies and how arrangements that occasion choice responses are used to measure preference. In the first section, choice is defined and each element in a choice contingency is reviewed with an emphasis on environmental arrangements that evoke choice responding. Hypothesized functions of choice and evidence on preference for choice opportunities are discussed. In the second section, preference is defined and then assessment methods to identify preferred stimuli are reviewed, including procedures that use selection methods and then duration measures. Practical step-by-step instructions, sample datasheets, and hypothetical results are shown for four of the most researched methods: single-stimulus (Pace et al., 1985, see Box 7.1), paired-stimulus (Fisher et al., 1992, see Box 7.2), multiple-stimulus-without-replacement (DeLeon & Iwata, 1996, see Box 7.3), and free-operant (Roane et al., 1998, see Box 7.4) preference assessments. Then, variables that affect choice and preference are reviewed, including the type of preference assessment, selection response, and dependent measure; type and number of stimuli and magnitude or duration of their access; motivating operations; the individual's prerequisite skills; and the ecological and cultural fit of the stimuli. Next, methods to validate preference assessment outcomes are reviewed, including social validity, reliability, and predictive validity. When appropriate, sections end with recommendations for best practice.

Choice

Choice is a fundamental part of the human experience. Adults make hundreds of choices each day from when they will wake up, what they will eat, what they will wear, what they watch or listen to, and if and how they will spend their discretionary money, to name just a few. Children make fewer choices as their caregivers often control the timing and content of daily activities such as providing meals, laying out clothes to wear, and making certain toys available. Nonetheless, children make choices when they don't eat the vegetables that were put on their plate, when they tantrum because their favorite shirt is not available, or when they play with one and not another available friend on the playground. As children get older, more choice opportunities become available such as who they want to invite over for a playdate, what they want as a birthday or holiday gift, and which electives to take in school. Children with autism and other developmental disabilities, however, make fewer choices than their neurotypical peers (Bannerman et al., 1990), and this is probably true even as they become older, particularly those who do not have robust verbal repertoires.

The provision of choice opportunities is embedded in the ethical standards for behavior analysts. The Behavior Analyst Certification Board Ethics Code (2020) has four core principles, one of which is to treat others with compassion, dignity, and respect. Some of the ways that behavior analysts demonstrate this core principle is by "acknowledging that personal choice in service delivery is important by providing clients and stakeholders with needed information to make informed choices about services," and relatedly by "respecting and actively promoting clients' self-determination to the best of their abilities, particularly when providing services to vulnerable populations" (p. 4).

Choice Behavior Defined

Choice behavior is demonstrated when an individual emits one of two or more available responses that are usually incompatible (e.g., sits or stands), or selects one of two or more available stimuli (e.g., points to X or points to Y). Catania (2013) distinguishes choice from precurrent responses such as deliberating: "Choice is not some other response that precedes the selection; it is the selection itself" (pp. 431–432).

Choice Contingencies

Choice involves a three-term contingency: (1) an environmental arrangement that evokes choice responding, (2) a choice response, and (3) consequences for the choice response. This contingency can also be affected by contextual variables and motivating operations. Each of these contingency elements will be discussed next.

Choice Responses

A *choice response* is a discrete response to one stimulus and not to another, but the response topography can vary depending on the individual's repertoire and the assessment arrangement. The following selection responses have been reported: contact with, picking up, pointing to, approaching, pressing a microswitch or button, reaching toward, shifting eye gaze to, verbally naming, and consuming a stimulus (Virues-Ortega et al., 2014). For this chapter, all these response types will be referred to generally as selection responses or selections.

Environmental Arrangements That Evoke Choice

Environmental arrangements that evoke choice responding include the concurrent availability of multiple stimuli or responses. Additionally, for choice responding to occur, there must not be socially mediated antecedent events that influence responding to one alternative such as coercion or prompting. Further, unless the intended choice response is for a reinforcement schedule, choice options should not be between alternatives with different reinforcement schedules operating as consequences, as these schedules will influence the selection of one stimulus over another.

Experimental analyses of choice and preference are typically conducted in concurrent schedules of reinforcement or concurrent-chains schedule arrangements. In a concurrent-operant arrangement or *concurrent schedule*, two or more independent schedules with distinctive discriminative stimuli and consequences are operating simultaneously, and the individual allocates responding to one schedule exclusively or alternates responding between the two schedule options. Each response under one of the schedules can be considered a choice response, and some dimension of responding, such as rate, duration, or intensity is measured and compared among the different concurrently available options. For instance, Geckeler et al. (2000) measured the rate of button presses on two simultaneously available, differently colored buttons. Button presses on both colored buttons were reinforced on the same fixed-ratio (FR) schedule but with different reinforcers. The data of interest were the rate of presses on each button as a measure of preference for the different reinforcers. In another concurrent schedule, Piazza et al. (1996) had three concurrently available chairs (or square areas demarcated on the floor) with different putative reinforcers on (or in) each; the unique reinforcer or no reinforcer (in the control) was delivered when the participant was in the associated chair (or square). A series of concurrent arrangements was conducted, and the data of interest were the total duration of in-seat (or in-square) behavior in each chair (square) as a measure of preference for the different stimuli.

In a *concurrent-chains schedule*, two or more simultaneous and independent schedules with distinctive discriminative stimuli (initial links associated with different consequences) are provided, and the individual selects one initial link, which produces the associated terminal link (and removes the other initial link). The associated consequence is provided when responding in the terminal link meets the reinforcement requirement. The concurrent-chains schedule functionally separates the choice response (initial link) and the subsequent responding to meet the reinforcement contingency (terminal link). Hanley et al. (2005) used a concurrent-chains arrangement to evaluate participants' preferences for different function-based treatments for their aggressive behavior. Differently colored microswitches were correlated with a reinforcement-only (functional communication training, FCT, to request attention), a reinforcement-plus-punishment (FCT and a brief hands-down consequence for aggression), or a punishment-only treatment. At the start of sessions, participants selected one of the three microswitches and an ensuing 2-min treatment session involved the contingencies associated with that colored microswitch. Frequency of microswitch presses was measured 8–10 times in a session for four to seven total sessions and the results showed differential selection of the microswitch associated with the reinforcement-plus-punishment treatment, which was also the most effective treatment for both participants diagnosed with intellectual disabilities or autism and intellectual disabilities. In another example, Castelluccio and Johnson (2019) used a concurrent-chains arrangement to evaluate the relative reinforcing effects of different break environments for two individuals with autism whose aggression and self-injury were maintained by escape from demands. In each trial, two to three different cards depicting multitask sequences, each associated with a distinct break environment (or no break) were presented. When a participant selected a card with one of the task sequences (initial link), the materials needed to complete those tasks were made available (terminal link) and completing the tasks in the specified order was reinforced with access to the associated break environment. Results showed that both participants selected the initial link associated with a previously identified highly preferred break environment more often than a less preferred break environment or no break (control), a less preferred break more often than no break, and that they completed the associated tasks without aggressions or self-injury to access the break environment.

Because choice responses are embedded in concurrent schedules (i.e., concurrent reinforcement or concurrent chains), they are more sensitive to preference and relative reinforcement value than single operant schedules when only one reinforcement schedule is operating (Geckeler et al., 2000). When two or more reinforcing stimuli are available concurrently, individuals will select the stimulus they most value (Fisher & Mazur, 1997), and therefore, we can directly observe their preferred stimulus at that moment.

Consequences of Choice Responses

Certain dimensions of the consequences that follow choice responses will affect future choice responses and indices of preference. These dimensions include the quality and quantity of the consequence (high or low value to the individual) and the timing of the consequence (immediately after the choice response, delayed, or no consequence). The quality of the consequential stimuli is how valued they are to the individual at the time they are delivered or made available. In the next section on preference and preference assessments, empirically validated procedures to predict the value of stimuli will be reviewed. Certain preference assessments will produce a hierarchy of preference, and identify top-ranked stimuli, often referred to as highly preferred (HP) stimuli, which are of most value to the individual and most likely to function as reinforcers. The quantity of the consequence, one of the variables that affects preference, will also be discussed later in the section titled, "Magnitude/Duration of Access Time."

A third dimension of choice consequences is whether and when the consequence is delivered. Although no or delayed access to a selected stimulus would be easier to arrange and manage, particularly in preference assessments that consist of a series of choice selections, these practices will affect the value of the stimulus as well as future choice responses.

Several research studies have demonstrated that no access to selected items affects the validity of future choice responses, making preference assessment results invalid for some individuals (e.g., Groskreutz & Graff, 2009; Heinicke et al., 2016; Kuhn et al., 2006; Tessing et al., 2006). For example, Hanley et al. (1999) compared preference assessment results with four individuals with autism and other developmental disabilities under two conditions: immediate and no access to selected items. In most cases, distinct preference hierarchies were only established when selection responses resulted in access to the item. No research studies were found that evaluated the effect of delayed access to selected stimuli in the context of preference assessments, likely because this would be impractical; in preference assessments, multiple-choice selections occur within a session which would obviate any one-to-one correspondence between a selection and a delayed consequence unless all selections were the same. There is, however, an abundance of basic, applied, and translational research on temporal discounting. Robust degradation effects have been shown in reinforcer value and reinforcer efficacy when there are delays to reinforcer delivery, with greater degradations with longer delays (e.g., Critchfield & Kollins, 2001; Fisher et al., 2000). For these reasons, best practices call for consequences to be provided immediately following choice responses, particularly when the goal is to reinforce choice responding or measure preference.

The Function of Choice Opportunities and Choice Responses

Research has evaluated whether choice opportunities provided when the response requirement is met function as reinforcement independent of the reinforcing effect of the stimuli themselves. The results seem to depend in part on the methodology used (Fisher & Mazur, 1997). Most studies using *single-operant arrangements* such as a multielement or alternating-treatment designs have reported no difference in response rates when choice of tasks or reinforcers were made available (e.g., Hanratty & Hanley, 2021; Lerman et al., 2013). On the other hand, single-operant arrangements using *progressive ratio* (PR) schedules have found that choice opportunities produced higher breakpoints than no-choice conditions (e.g., Tiger et al., 2006), suggesting that choice of reinforcers served a reinforcing function. In studies using concurrent-operant arrangements, reinforcer choice selections were found to reinforce behavior that produced the choice opportunity (e.g., Geckeler et al., 2000; Fisher et al., 1997). Fisher et al. (1997) found nearly exclusive free-operant responding to the key associated with reinforcer choice than to the key associated with no choice.

Current research has evaluated choice opportunities and selections as *antecedent events* before the dependent variable response and as *consequence events* after the dependent variable response. Choice opportunities before a work requirement may entail an "if-then" contingency: "If you do X, then you can earn Y" where the Y stimulus is preselected by the individual, or a choice opportunity: "What do you want to earn?" Choice opportunities after a work requirement entail providing a choice among stimuli as part of the reinforcement contingency. In other words, choice opportunities after a work response may *function as reinforcement* for work. On the other hand, choice opportunities before work responses may function as discriminative stimuli, signaling that reinforcement is available for responses that have been reinforced in the past after choice responses were made; or as *motivating operations* that momentarily increase the reinforcing value of the stimulus selected when delivered contingently (Peterson et al., 2016).

Peterson et al. (2016) found higher levels of responding on maintenance tasks for two of four children with autism when pre-task (i.e., antecedent) reinforcer choice arrangements were used rather than post-task choice (i.e., consequence) arrangements. The other two children showed no clear differences in responding based on when choice arrangements were provided. In a subsequent concurrent choice assessment, three of the four children preferred pre-task over post-task choice opportunities as indicated by selecting the materials associated with this choice arrangement; the other child preferred the post-task choice arrangement. More recently, Gureghian et al. (2020) found faster acquisition of auditory-visual conditional discriminations (matching spoken words to their corresponding pictorial stimuli) in two of three children with autism when choice of reinforcers was a consequence rather than an antecedent event. More research is needed to determine if these differences in results are an artifact of the procedural differences (maintenance versus acquisition tasks, progressive ratio versus token economy with backup reinforcers), or if preference and efficacy of reinforcer choice are idiosyncratic across individuals.

Preference for Choice

When concurrent operant arrangements such as concurrent or concurrent-chains schedules are used, choice-making opportunities have been shown to be preferred over no choice. In the methodology used in Geckeler et al. (2000), described earlier, participants were given the opportunity to choose one edible from an array of three different highly preferred edibles when the FR schedule requirement was met on one colored button or one of the three high preference edibles that the experimenter quasi-randomly selected when the same FR schedule requirement was met on the other colored button. All three children with autism allocated more responding, sometimes exclusively, to the colored button associated with choice than to the button associated with no choice. Whereas responding to the choice option may have maximized reinforcement by procuring the most preferred edible more often, similar results have been shown when the no-choice reinforcer is yoked to the choice reinforcer (Fisher et al., 1997). In concurrent-chains arrangements, Hanratty and Hanley (2021) found that both elementary-aged children with disabilities and three of four children without disabilities preferred the consequence of choosing a stimulus from an array more than having a stimulus presented, even though the same stimuli were used contingently in both conditions. There appears to be ample empirical evidence that individuals prefer to have choice opportunities as they will most often choose choice opportunities to no-choice opportunities.

Preference

The role of preference is increasingly being incorporated into social policies and professional practices. Assessing and incorporating client preference is incumbent upon service providers in the education and treatment of individuals with autism and other developmental disabilities. For instance, skills related to client preference are integrated into the Behavior Analyst Certification Board (2017) BCBA Task List (5th edition), which is the list of knowledge and skills in the board-certified behavior analyst credentialing exam and in which behavior analysts are expected to be competent. In subsection F, Behavior Assessment, there is a specific item, F-5, "Conduct preference assessments" (p. 4); in subsection, H, Selecting and implementing interventions, there is a specific item, H-3, "Recommend intervention goals and strategies based on such factors as client preferences, supporting environments, risks, constraints, and social validity" (p. 5). Similar knowledge and skills related to preference are incorporated into the Behavior Analyst Certification Board (2022) BCBA Test Content Outline (6th edition). Behavior analysts and other service providers to children with autism need to consider clients' preferences in the design and delivery of services. The remainder of this chapter will focus on preference assessment methods and considerations.

Preference Defined

Preference is inferred from repeated measures of choice responding and the resulting pattern of selections across time. Across repeated choice opportunities when one or more responses or stimuli are concurrently available, the probability of each response or stimulus selection can be derived. Those responses or stimuli with higher probabilities are more preferred and those with lower probabilities, less preferred. Preference is a relative measure that predicts the future relative effectiveness of different stimuli as reinforcers. Catania (2013) articulates, "the organism is said to prefer the consequences produced by the response that is most probable" (p. 456). Assessment methods to determine preferences will be reviewed in the ensuing sections.

Stimulus Preference Assessment Methods

Until approximately 1995, indirect assessments were the mainstay procedure to infer preferred stimuli to incorporate into treatment programs for individuals with autism and other intellectual or developmental disabilities (see Favell & Cannon, 1977; Rynders & Friedlander, 1972; Witryol & Fischer, 1960 for some notable exceptions). *Indirect assessments* ask respondents, typically caregivers, using surveys, checklists, or interviews, to rate different stimuli based on their perception of how much the client likes them (e.g., Atkinson et al., 1984; Fisher et al., 1996) so that the presumed most preferred stimulus can be used contingently. Results from indirect preference assessments, however, often correspond poorly with the outcomes of more systematic direct assessments (e.g., Cote et al., 2007; Green et al., 1988; Kenzer & Bishop, 2011). Current best practices include the use of indirect methods such as the Reinforcer Assessment for Individuals with Severe Disability (Fisher et al., 1996) to determine which stimuli to assess directly.

A rich technology of direct assessments has been developed over the past 35 years to identify preferred stimuli to provide noncontingently in order to enrich environments or to use contingently as positive reinforcers. *Direct preference assessment methods* include repeated presentations of two or more stimuli such that differential responding among stimuli can be measured. One of two dependent measures is used: selection (i.e., choice responses) or duration of engagement. In the next sections, the different arrangements used with each of these dependent measures will be reviewed.

Direct Assessments That Use Selection Measures

Selection is a per opportunity measure in which the stimulus selected is recorded. Direct assessments using selection measures differ by the number of stimuli (one, two, or multiple) presented simultaneously, and whether stimuli are replaced or replenished after a selection is made.

Single-Stimulus Preference Assessments

The first systematic stimulus preference assessment used with individuals with intellectual and developmental disabilities involved repeated trials with a specific set of stimuli, preexperimentally selected for their variation in sensory consequences (i.e., olfactory, gustatory, visual, auditory, tactile, vestibular, social), presented one at a time, and approach (or selection) measured for each item (Pace et al., 1985). Across eight sessions, each stimulus was presented a total of 10 times and preference for a particular stimulus was inferred by the probability of approach responses. Stimuli were considered highly preferred if they were selected on at least 80% of trials, and nonpreferred if they were selected on 50% or fewer trials. When contingent access to preferred stimuli was compared to contingent access to nonpreferred stimuli in subsequent reinforcer assessments, there were higher levels of correct responding when preferred stimuli were delivered. These results validated that preferred stimuli are more likely to function as reinforcers than nonpreferred stimuli.

By presenting just one stimulus at a time, *single-stimulus methods* measure if the client will or will not reliably select X, where X represents each stimulus assessed. This method distinguishes preferred and nonpreferred stimuli, but may not distinguish relative preference among preferred stimuli, and therefore may falsely identify some high preference items. Because of this limitation, other methods, described in the next section, are more commonly reported in the research literature (Virues-Ortega et al., 2014).

There are at least four situations, however, when the single-stimulus method may be the most appropriate method to assess preference. First, a single-stimulus method may be best when your assessment goal is only to evaluate if a singular stimulus is preferred (Virues-Ortega et al., 2014). Second, this method may be appropriate if clients do not make valid selection responses when two stimuli are presented. For example, when a client does not make any selection response when two stimuli are presented simultaneously, or when a client's selection response is not controlled by the stimulus selected but by the position in which it is placed (i.e., biased responding to the left or right; DeLeon et al., 2014). Third, this method may be used when selection measures are being used and the client's selection response is eye gaze (Ivancic & Bailey, 1996). Fourth, the single-stimulus preference assessment may be advantageous when the assessment goal is to identify a large pool of preferred stimuli to use in programming or in additional preference assessments.

Box 7.1 provides step-by-step instructions to conduct a single-stimulus preference assessment and a blank data sheet.[1] A sample data sheet and hypothetical results are presented to illustrate how preferred stimuli are determined based on the percentage of selections (i.e., the number of times a stimulus was selected divided by the number of times that stimulus was presented and multiplying that quotient by 100).

Paired-Stimulus Preference Assessments

Presenting two or more stimuli concurrently creates a choice paradigm. When these same stimuli are repeatedly presented, the probability of selection for each stimulus can be derived, creating a preference hierarchy. Paired-stimulus arrangements are the most prevalently reported preference assessment arrangements. In a recent review by Virues-Ortega et al. (2014), paired-stimulus preference assessments accounted for nearly 50% of all preference assessments reported in the research literature and were the most used format with individuals with all three populations included in the review: intellectual disabilities, autism, and sensory impairments. It is also the most used stimulus preference assessment used by behavior analysts in practice (Graff & Karsten, 2012).

In the first published account of a paired-stimulus preference assessment, Fisher et al. (1992) compared the outcomes from a single-stimulus and a paired-stimulus assessment. In the *paired-stimulus assessment*, two stimuli were presented at a time, and data were recorded on which stimulus was selected. Across a series of trials, each stimulus was paired with every other stimulus an equal number of times and presented equally often on the participant's left and right. The mean percentage of selection responses to each stimulus was calculated. Greater response differentiation was shown when there was a choice between two stimuli than when just one was presented. The paired-stimulus preference assessment produced a preference hierarchy; the stimuli could be rank ordered from the stimulus with the greatest number of selections, or the HP, to the stimulus with the lowest number of selec-

[1] Pace et al. (1985) assessed 16 stimuli. The example here is simplified and uses only six items.

Box 7.1 Conducting a single-stimulus preference assessment (adapted from Pace et al., 1985)

Steps:

1. Determine which 5-10 stimuli to assess.
2. Determine and define dependent measure:
   a. Selection topography (also determine duration of access per selection), or
   b. Duration of interaction per stimulus (also determine maximum duration per stimulus)
3. Create a data sheet with 5-10 columns for different assessment opportunities and a row for each stimulus to be assessed.
4. Assessment session procedures
   a. Randomly select presentation order of stimuli (1-2 presentations/stimulus/session)
   b. For each stimulus presentation, present one stimulus approximately 8 inches from client
      i. If selected within 5 s, provide access for 5 s. Record +
      ii. If not selected within 5 s, remove stimulus and present again with prompts to look at/engage, and then present again for 5 s without prompts. Record + if selected, - if not selected.
5. Calculate the percentage of times each stimulus was selected and determine if it is preferred.
   a. Percentage of trials selected: Divide the number of times a stimulus was selected by the number of times it was presented and multiply the quotient by 100.
   b. Preferred stimulus selected ≥ 80%.
   c. Nonpreferred stimulus selected ≤ 50%.

Sample blank data sheet:

	Date 1	Date 2	Date 3	Date 4	Date 5	#
Stimulus 1						
Stimulus 2						
Stimulus 3						
Stimulus 4						
Stimulus 5						
Stimulus 6						

Hypothetical raw data:

	3/1/22	3/2/22	3/4/22	3/8/22	3/9/22	#
Slinky	+ -	+ -	- -	- -	- -	2
Clay	- +	+ +	+ -	- +	+ +	7
Bubbles	+ +	+ +	+ +	- +	+ -	8
Music	+ +	+ +	+ +	+ +	+ +	10
Markers	- +	- -	- -	- -	- -	1
Puzzle	+ +	- +	+ -	+ -	- +	6

Hypothetical results:

Percentage of trials selected

Music: 100% (10/10)
Bubbles: 80% (8/10)
Clay: 70% (7/10)
Puzzle: 60% (6/10)
Slinky: 20% (2/10)
Markers: 10% (1/10)

Summary

- Music and bubbles were preferred.
- Markers and slinky were nonpreferred.

tions, or least preferred (LP). Subsequent reinforcer assessments demonstrated that stimuli identified as HP were associated with higher response rates on simple tasks than stimuli identified as LP on the paired-stimulus assessment, even when those LP stimuli were designated as preferred on the single-stimulus assessment. These findings suggested that paired-stimulus assessments are more sensitive measures of preference than single-stimulus assessments.

The paired-stimulus preference assessment is probably the best default method if a practitioner can only implement one method across their caseload or does not know a client well, such as during an intake or a short-term clinic placement. It involves the minimal number of stimuli (two) to evoke choice responding; therefore, the attending and scanning demands on the client are less than when multiple stimuli are presented. In addition, the limited number of stimuli allows for bulkier items to be arranged on a table in front of the client. One disadvantage to this assessment is that it takes more time to implement than the single-stimulus assessment (Fisher et al., 1992), and since every stimulus is paired with every other stimulus, the time requirement increases exponentially when more stimuli are included (e.g., 30 trials to assess six stimuli, 132 trials to assess 12 stimuli, 240 trials to assess 16 stimuli).

Box 7.2 provides step-by-step instructions to conduct a paired-stimulus preference assessment and a blank data sheet.[2] A sample completed data sheet and hypothetical results are presented to illustrate how rank orders of preferred stimuli can be derived from the percentage of times stimuli are selected (i.e., the number of times a stimulus was selected divided by the number of times that stimulus was presented and multiplying that quotient by 100).

Multiple-Stimulus Preference Assessments

In the first published study evaluating *multiple-stimulus assessments*, Windsor et al. (1994) compared the results from eight adults with severe to profound disabilities on their preference for six edibles when assessed in two different formats: paired- and multiple-stimulus trial arrangements. Stimuli were positioned in a linear fashion about 2 in. apart from each other on a tray. In the paired-stimulus assessment, each of six stimuli was presented once with every other stimulus in the left and right positions for a total of 30 trials; in the multiple-stimulus preference assessment, all six stimuli were presented at the same time, with each stimulus in each position one or two times, for a total of 10 trials. Participants were exposed to five assessments in each format, alternating between the two formats in consecutive sessions. These researchers noted several findings: (1) both formats yielded the same top- and bottom-ranked stimuli for six and seven of the eight participants, respectively, (2) the paired-stimulus assessment yielded more differentiation among the middle-ranked stimuli and showed more stability of rankings across assessment administrations than the multiple-stimulus format, (3) the multiple-stimulus format was considerably more time-efficient. These researchers did not conduct reinforcer assessments, which could indicate if results from one of these formats were a better predictor of reinforcer efficacy.

DeLeon and Iwata (1996) compared two variations of multiple-stimulus preference assessment procedures to the paired-stimulus preference assessment (Fisher et al., 1992). One format was like Windsor et al. (1994), referred to as the multiple-stimulus-with-replacement preference assessment, in which all stimuli were presented in every trial. In the other format, referred to as the *multiple-stimulus-without-replacement preference assessment or MSWO*, selected items were not presented in subsequent trials in the same assessment. Whereas good correspondence in the top-ranked stimulus was found in all three assessment formats, the MSWO was more strongly correlated with the paired-stimulus than the multiple-stimulus assessment without replacement. Because the same high preference item could be selected on every trial, preference for stimuli other than the top-ranked one could be masked when stimuli were replaced. The MSWO, then, has the same advantage as the paired-stimulus format in providing a differentiated ranking, without the disadvantage of the paired-stimulus format in the time required to conduct trials pairing each stimulus with every other stimulus.

Recent research (Carr et al., 2000; Conine et al., 2021; Higbee et al., 2000) has found that the efficiency of the MSWO can be enhanced by conducting three rather than five blocks of trials without adversely affecting its predictive validity. Researchers have cited that the brief (3-session) MSWO takes 5 min (Carr et al., 2000; Richman et al., 2016).

[2] Fisher et al. (1992) assessed 16 stimuli. The example here is simplified and uses only six items.

Box 7.2 Conducting a paired-stimulus preference assessment (adapted from Fisher et al., 1992)

Steps:

1. Determine which 5-12 stimuli to assess.
2. Define dependent measure: selection topography (also determine duration of access per selection).
3. Develop data sheet that presents each stimulus with every other stimulus in both the left and right position.
4. Assessment session procedures
    a. For each trial, present two stimuli equidistant and approximately 8 inches from client
        i. If one stimulus is selected within 5 s, remove the other stimulus, and provide access for 5 s. Circle stimulus selected.
        ii. If no stimulus is selected within 5 s, remove stimuli, and present each stimulus with prompts to look at/engage, and then present both stimuli again for 5 s without prompts. Circle stimulus selected.
        iii. If there is an attempt to select both stimuli at the same time, block contact and represent stimuli.
5. Calculate the percentage of times each stimulus was selected; determine its rank order and if it is preferred
    a. Percentage of trials selected: Divide the number of times a stimulus was selected by the number of times it was presented and multiply the quotient by 100
    b. Assign a rank order to each stimulus based on the percentage of trials selected. Rank 1 is the stimulus selected in the highest percentage of trials, Rank 2, the stimulus selected in the next highest percentage of trials, and so on.
    c. Preferred stimulus selected ≥ 80%.
    d. Nonpreferred stimulus selected ≤ 60%.

Sample blank data sheet:

Trial	L	R	Trial	L	R	Trial	L	R	Trial	L	R
1	1	2	9	3	1	17	1	4	25	4	1
2	3	4	10	4	6	18	2	1	26	5	4
3	6	3	11	1	5	19	5	3	27	1	6
4	5	1	12	4	3	20	3	2	28	3	5
5	2	4	13	5	6	21	6	4	29	6	2
6	6	5	14	2	5	22	2	6	30	2	3
7	3	6	15	6	1	23	4	5	L= Left		
8	4	2	16	5	2	24	1	3	R= Right		

1 = 2 = 3 = 4 = 5 = 6 =

Hypothetical raw data:

Trial	L	R	Trial	L	R	Trial	L	R	Trial	L	R
1	1	2	9	3	1	17	1	4	25	4	1
2	3	4	10	4	6	18	2	1	26	5	4
3	6	3	11	1	5	19	5	3	27	1	6
4	5	1	12	4	3	20	3	2	28	3	5
5	2	4	13	5	6	21	6	4	29	6	2
6	6	5	14	2	5	22	2	6	30	2	3
7	3	6	15	6	1	23	4	5			
8	4	2	16	5	2	24	1	3			

1 = Slinky, 2 = Clay, 3 = Bubbles, 4 = Music, 5 = Markers, 6 = Puzzle

Hypothetical results:

Rank and percentage of trials selected

Rank 1: Music: 100% (10/10)
Rank 2: Bubbles: 80% (8/10)
Rank 3: Puzzle: 60% (6/10)
Rank 4: Clay: 30% (3/10)
Rank 5: Markers: 20% (2/10)
Rank 6: Slinky: 10% (1/10)

Summary

- Music and bubbles, ranked 1 and 2, were the most highly preferred.
- Slinky and markers, ranked 5 and 6, were the least (or not) preferred.

The MSWO preference assessment is likely the most efficient and effective method if the array of stimuli being assessed can fit on a table, and the client has the attending and scanning skills required to select one stimulus from many.

Box 7.3 provides step-by-step instructions to conduct a MSWO and a blank data sheet[3]. A sample completed data sheet and hypothetical results are presented to illustrate how rank orders of preferred stimuli can be derived from the percentage of times stimuli are selected (i.e., the number of times a stimulus was selected divided by the number of times that stimulus was presented before it was selected and multiplying that quotient by 100).

[3]DeLeon and Iwata (1996) assessed 7 stimuli. The example here uses only six items to be consistent with earlier examples of other assessment formats.

Box 7.3 Conducting a multiple-stimulus-without-replacement (MSWO) preference assessment (adapted from Deleon & Iwata, 1996)

Steps:

1. Determine which 5-8 stimuli to assess.
2. Define dependent measure: selection topography (and also determine duration of access per selection).
3. Create a data sheet to record which stimulus was selected on each trial.
4. Before an assessment, provide access to each stimulus (consumption or 30 s).
5. Assessment block procedures
   a. Arrange stimuli for Trial 1. Stimuli should be presented in a linear fashion, approximately 5 cm apart. Across session blocks, vary the position of the stimuli in Trial 1.
   b. Ask client to "Pick one."
   c. If a stimulus is selected within 30 s
      i. Provide access to selected item (consumption if edible, 30 s if leisure item).
      ii. Record stimulus selected.
      iii. Rotate remaining stimuli for next trial (move stimulus in left-most position to right-most position and equally space remaining stimuli). Do not replace the selected stimulus.
      iv. Repeat i-iii until all stimuli have been selected or no selection in 30 s.
6. Repeat procedures for 2 (i.e., Brief MSWO, Carr et al., 2000) or 4 additional blocks of trials
7. Calculate the percentage of times each stimulus was selected and determine its rank order
   a. Percentage of trials selected: Divide the number of times a stimulus was selected by the number of times it was presented and multiply the quotient by 100.
   b. Assign a rank order to each stimulus based on the percentage of trials selected. Rank 1 is the stimulus selected in the highest percentage of trials, Rank 2, the stimulus selected in the next highest percentage of trials, and so on.

Sample blank data sheet:

B1/ Trial	S	B2/ Trial	S	B3/ Trial	S	B4/ Trial	S	B5/ Trial	S
1		1		1		1		1	
2		2		2		2		2	
3		3		3		3		3	
4		4		4		4		4	
5		5		5		5		5	
6		6		6		6		6	

1 = 2 = 3 = 4 = 5 = 6 =
B= Block S= Stimulus selected

Hypothetical raw data:

B1/ Trial	S	B2/ Trial	S	B3/ Trial	S	B4/ Trial	S	B5/ Trial	S
1	4	1	4	1	4	1	4	1	4
2	3	2	3	2	6	2	3	2	6
3	6	3	6	3	3	3	6	3	3
4	5	4	2	4	2	4	2	4	2
5	2	5	5	5	5	5	5	5	5
6	1	6	1	6	1	6	1	6	1

1 = Slinky, 2 = Clay, 3 = Bubbles, 4 = Music, 5 = Markers, 6 = Puzzle

Hypothetical results:

Rank and percentage of trials selected
Rank 1: Music: 100% (5/5)
Rank 2: Bubbles: 42% (5/12)
Rank 3: Puzzle: 38% (5/13)
Rank 4: Clay: 24% (5/21)
Rank 5: Markers: 21% (5/24)
Rank 6: Slinky: 17% (5/30)

Summary

- Music, Rank 1, was the most highly preferred.
- Slinky, Rank 6, was the least (or not) preferred.

Direct Assessments That Use Duration Measures

Duration measures capture the amount of time from the beginning to the end of responding. Direct assessments using duration measures differ by the number of stimuli presented at the same time and whether stimuli are replaced or replenished across trials when there are multiple stimuli.

Single-Stimulus Preference Assessments

DeLeon et al. (1999) used a single-stimulus preference assessment with duration measures when an MSWO using selection measures led to an undifferentiated preference hierarchy. In this procedure, each leisure item was presented singly in a randomized order for 2 min, and the duration of contact time with each stimulus was recorded. An assessment was conducted as a series of 2-min stimulus presentations, and the assessment was replicated five times. The researchers hypothesized that items engaged with for a cumulative duration of 50% or more of the duration the item was available were likely preferred, even if selection measures had not indicated preference for that stimulus. Reinforcer assessments for both participants showed that stimuli with low and undifferentiated selection measures in the MSWO (approximately 25% of trials selected) and duration measures greater than 50% in the single-stimulus assessment functioned as reinforcers. Furthermore, stimuli with low and undifferentiated selection measures in the MSWO (approximately 25% of trials selected) and duration measures less than 50% in the single-stimulus assessment did not function as reinforcers for the one participant with whom this control procedure was implemented. The researchers concluded that the single-stimulus preference assessment using duration measures is a viable approach when several stimuli in MSWO are highly preferred and compete in concurrent arrangements such that the results are undifferentiated. In these cases, duration measures may yield differentiated results.

Worsdell et al. (2002) conducted a single-stimulus preference assessment for vocational tasks using duration measures when a free-operant preference assessment (described in the next section) yielded exclusive responding to one task activity. In the single-stimulus assessment, seven different assembly tasks were presented singly for 5 min and duration of engagement was estimated through 10-s partial interval recording. The results obtained from the single-stimulus assessment were predictive of the participants' engagement in the tasks in 60-min criterion tests, which were implemented to replicate typical work conditions.

The single-stimulus preference assessment using duration measures is less researched than other assessment formats. This procedure takes substantially longer than the single-stimulus preference assessment using selection measures or a multiple-stimulus free-operant preference assessment using duration measures. For these reasons, the single-stimulus preference assessment using duration measures is only recommended as a remedial procedure when the clinical need is for a preference hierarchy and the results from the standard preference assessment formats show undifferentiated responding.

Multiple-Stimulus Preference Assessments

Roane et al. (1998) evaluated a 5-min *free-operant preference assessment* with multiple stimuli. Participants could engage with (manipulate) any of the stimuli and the duration of engagement with each stimulus was measured. Preference hierarchies were established by ranking stimuli by the duration of engagement with them. Subsequent reinforcer assessments indicated that the derived hierarchies had good predictive validity in that items engaged with for longer durations were more likely to function as reinforcers than items that were engaged with for shorter durations. The authors asserted that an advantage of using duration rather than selection measures is that stimuli do not need to be withheld or withdrawn after a short-access interval (typically 5–30 s), which might evoke challenging behavior. In fact, there is empirical support that the free-operant assessment is associated with less challenging behavior when assessing preferences for tangible items than the paired-stimulus or MSWO assessments (e.g., Kang et al., 2011).

A limitation to the free-access format, like the multiple-stimulus with replacement format, is that an individual can allocate all responding to one stimulus, and thus, a differentiated preference hierarchy may not be identified. Without differentiation, there is the possibility of false negatives, leading to the misidentification of potential reinforcers. Hanley et al. (2003) overcame this limitation using a *response-restriction procedure*. Once a preferred stimulus was identified based on pre-established criteria, it was removed, and the assessment was readministered with the remaining stimuli. These procedures continued until all stimuli were removed or there was no engagement with any of the remaining stimuli. Like the MSWO, the response restriction method guarantees that the individual allocates responding to more stimuli. When duration measures are used, however, the time required to complete the assessment increases such that it may no longer be an efficient method.

The main reason to use a duration-based preference assessment is when removing a stimulus after a short-access duration is aversive to a client and will affect assessment outcomes. If the removal of stimuli is aversive and the desired assessment outcome is a hierarchy of preferred stimuli, then the restricted stimulus method (Hanley et al., 2003) should be considered. On the other hand, if the removal of stimuli is aversive and the desired assessment outcome is the identification of the most highly preferred stimulus, the free-operant method (Roane et al., 1998) should be considered. The free operant arrangement does not involve repeated trials, and because of this, it may also be the best option when assessment stimuli are heavy or otherwise difficult to present and remove within sessions (Johnson & Graff, 2023).

Box 7.4 provides step-by-step instructions to conduct a 5-min free-operant preference assessment based on the procedures of Roane et al. (1998). A sample data sheet and hypothetical results[4] are presented to illustrate how the most highly preferred stimulus can be derived from the percentage of intervals in which stimuli are manipulated (i.e., the number of intervals a stimulus was manipulated divided by the number of intervals in the assessment and multiplying that quotient by 100).

[4] Roane et al. (1998) assessed 10–11 stimuli. The example here uses only six items to be consistent with earlier examples of other assessment formats.

Variables That Affect Choice and Preference

In the preceding section, considerations in deciding which preference assessment method to use were highlighted. In this section, variables that may affect choice and preference and considerations in the planning of direct preference assessments related to these variables are reviewed.

Stimulus Selection

Early stimulus preference assessments included an array of stimuli that sampled different sensory modalities (Fisher et al., 1992; Pace et al., 1985). For instance, Pace et al. used the same 16 stimuli for each of their six participants with profound intellectual disabilities: mirror and light (visual), song and beep (auditory), coffee grounds and flower (olfactory), juice and graham cracker (gustatory), vibrator, fan, heat pad, and cool block (tactile), swing, rocking chair (vestibular), and clapping and hug (social). Stimuli were all represented by physical items. For instance, the mirror was held near the participant; a hug was represented as the therapist's hands outstretched toward the participant.

The inclusion of both consumable and non-consumable items in the same choice arrangements may skew preference indices toward the consumable items (Bojak & Carr, 1999; DeLeon et al., 1997), or less frequently toward the non-consumable item (Sipila-Thomas et al., 2021). DeLeon et al. conducted one preference assessment with just edible items, and another with just leisure items, and a third assessment with the most preferred items from the other two assessments. An edible item was the most preferred stimulus in the combined edible and nonedible assessment for 12 of the 14 participants with moderate or profound intellectual disabilities. The researchers concluded that "food items readily displaced leisure items in the combined assessment, even though the leisure items were highly preferred in the absence of food" (p. 479). Fahmie et al. (2015) found this displacement effect to be as likely with individuals

Box 7.4 Conducting a free-operant preference assessment (adapted from Roane et al., 1998)

Steps:

1. Determine which 6-12 stimuli to assess.
2. Dependent measure:
   a. Define manipulation topographies.
   b. Determine duration of observation intervals.
   c. Duration measure: Percentage of intervals each stimulus was manipulated (partial-interval sampling method).
3. Create a data sheet to record stimuli engaged with or consumed during each 10-s interval.
4. Before an assessment, bring client to each stimulus and prompt sampling it (consumption or manipulation).
5. Assessment procedures:
   a. Arrange stimuli in a circle.
   b. Run sampling procedure (#4 above).
   c. Bring student away from stimuli and start assessment.
      i. Record each stimulus manipulated in each interval (can be more than one stimulus).
      ii. Replace items as needed.
      iii. Repeat i-ii until 5 min have elapsed.
6. Calculate the percentage of intervals each stimulus was manipulated and determine the stimulus manipulated for the highest duration estimate.
   a. Percentage of intervals: Divide the number of intervals a stimulus was manipulated by the number of intervals in the session and multiply the quotient by 100.
   b. Determine the stimulus with the highest percentage of intervals with manipulation, which estimates duration.

Sample blank data sheet:

In each 10-s interval, record a +
for each stimulus manipulated

Inter-val #	S1	S2	S3	S4	S5	S6
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

S1= S2= S3= S4= S5= S6=

Hypothetical results:

Percentage of intervals
Music: 70% (21/30)
Bubbles: 40% (12/30)
Puzzle: 33% (10/30)
Clay: 27% (8/30)
Markers: 17% (5/30)
Slinky: 7% (2/30)

Summary
Music was the most highly preferred.

diagnosed with autism as with intellectual disabilities.

Even though other researchers have reported less displacement of leisure items by edible items (e.g., Conine & Vollmer, 2019; Sipila-Thomas et al., 2021), particularly when the duration of access to leisure items is increased (e.g., Clark et al., 2020), it is recommended that practitioners conduct separate preference assessments for edible and leisure items.

Some items, particularly leisure items, social stimuli, and combinations of stimuli, are challenging or impossible to present as tangible items in a choice arrangement. For instance, how can one provide a choice arrangement for swings on the playground or a mechanical toy in the classroom, or for a social conversation or a break with an iPad? These stimuli cannot be lined in an array on a table. Researchers have used representations of stimuli or events in preference assessments, such as verbally stated names, pictures, or videos to represent the events that will follow their selection. To produce valid and reliable results, each of these alternate formats, however, requires participants to have certain prerequisite skills and regardless of the format of choice arrangements, the consequence for a choice response must be the immediate delivery of the selected item (e.g., Groskreutz & Graff, 2009; Hanley et al., 1999; Heinicke et al., 2016; Kuhn et al., 2006; Tessing et al., 2006).

Researchers have used vocal-verbal representations in paired-stimulus preference assessments (e.g., Cohen-Almeida et al., 2000; Kuhn et al., 2006; Tessing et al., 2006). On each trial the participant is typically asked, "Do you want X or Y?" and the participant selects the preferred stimulus by vocally stating the name of one of the items or activities. Each stimulus is stated once with every other stimulus as both the first- and the second-named item. This type of assessment has been used to identify preferences for tangible stimuli (e.g., Tessing et al.), social stimuli (e.g., Kuhn et al.), and preferred and nonpreferred staff (Jerome & Sturmey, 2008). Prerequisites for verbal preference assessments include relational stimulus control by spoken names and the assessment items (i.e., auditory-visual conditional discrimination; Conyers et al., 2002). Additionally, if the selection response is a vocal–verbal response, another prerequisite is functional vocal-verbal responses and not just echoic responses.

Researchers have also used pictures to represent items or events in paired-stimulus (Graff & Gibson, 2003; Heinicke et al., 2016) and MSWO preference assessments (e.g., Higbee et al., 1999; Morris & Vollmer, 2019). Pictures may include a snapshot of a tangible stimulus in the environment (i.e., the swing in the participant's backyard), a snapshot of a representational stimulus (i.e., a picture downloaded from the internet of a swing like the one in the participant's backyard), or a snapshot with the participant engaging with the tangible stimulus (i.e., the participant on the swing in the backyard being pushed by a sibling or parent). Pictorial preference assessments have been used to identify preferences for a variety of stimuli, including recreational activities such as riding a bike or playing basketball (e.g., Hanley et al., 1999), social stimuli such as verbal praise or high fives (e.g., Kelly et al., 2014), preferred break environments such as breaks with attention from a teacher or breaks with toys and no attention (Castelluccio & Johnson, 2019). Other studies have used other static two-dimensional representations such as different colored coupons with line drawings (Northrup et al., 1996), and different colored shapes and clipart (Morris & Vollmer, 1999, 2020), which likely require similar prerequisites as pictures (however, see Morris & Vollmer, 2020). Prerequisites for pictorial preference assessments include relational stimulus control between pictures and the stimuli and events they represent (i.e., visual–visual arbitrary conditional discrimination; Clevenger & Graff, 2005; Conyers et al., 2002; Morris & Vollmer, 2020).

Recently, researchers have evaluated the use of video stimuli in preference assessments, in which two or more video clips of individuals engaging with a stimulus are displayed concurrently, and the participant selects one video clip. Videos have the advantage of visually capturing movement, the displacement of physical items in the environment such as the to-and-fro movement of a swing when it is swinging, and for this reason, videos are best suited to assess toys or activity-based events. Video-based preference assessment outcomes have been found to have good correspondence with tangible assessments when presented in a paired-stimulus format (Snyder et al., 2012) and a MSWO format (Brodhead et al., 2016b).

The use of videos in preference assessments is still relatively new and no studies were found that evaluated prerequisite skills for the video format to yield valid results. Brodhead et al. (2016a), however, reported an easy and brief preexperimental assessment evaluating the utility of a video-based preference assessment. After establishing possible activities to include in an assessment, they conducted five successive trials in which a brief video of an activity was shown to the potential participant, and the experimenter then said, "Go there." Participants included in the study accurately guided the experimenter to each of the five depicted activities.

Another important consideration in the selection of stimuli to include in a stimulus preference assessment is the *ecological fit* (DeLeon et al., 2014). DeLeon et al. asserted that an ecological fit is one in which the preferred stimulus is both effective as a reinforcer but also is available and feasible to use in contingencies within the individual's environment. Preferred stimuli are an ecological fit if they are readily available (i.e., replenishable, easily delivered, and affordable) and not disruptive to the ongoing activities in the environment. For example, the delivery of a pair of headphones to listen to a song after completing a set amount of classwork would represent a better ecological fit than a speaker that would broadcast the song to the whole class. In addition, behavior analysts should consider the *cultural fit* of stimuli that will be used contingently. Knochel et al. (2020) demonstrated that verbal praise statements adapted by those from the culture in which the praise statements would be delivered were more effective than those developed by researchers less familiar with the cultural norms.

When selecting the stimuli to include in a preference assessment it is important to consider the skills of the individual, their treatment goals, and when and where the reinforcing stimuli will be delivered. For individuals who do not have picture-object relations, use objects in the preference assessment. Use pictures or other two-dimensional stimuli that best correspond to an individual's discrimination skills. It is likely that pictures of actual stimuli in the environment (e.g., the swing in the backyard) are more readily discriminable than ones that are representational of the stimulus class (e.g., a swing from the internet). For some participants, pictures of themselves engaging in activities may be more discriminable of the activity (e.g., on the swing being pushed in the backyard) than the picture of the stimulus alone (e.g., swing in backyard), but for others the addition of themselves in the pictures may encourage restricted stimulus control by which the pictured activity does not exert control over selection responses. The number of stimuli to include in choice arrangements should be based on the individual's scanning skills to promote valid choice selections. If the individual does not reliably scan individual stimuli before responding, conduct single-stimulus preference assessments. If their scanning is limited, use the paired-stimulus method.

If the treatment goal is to increase the pool of preferred stimuli that can be used to enrich the environment or to use contingently, one may want to consider an array of stimuli that sample different sensory modalities, including novel stimuli with preassessment exposure trials. On the other hand, if the treatment goal is to identify a hierarchy of preferred stimuli that will all function as reinforcers albeit to varying degrees, then one may want to conduct an indirect assessment first and use caregiver-nominated stimuli in the assessment. The stimuli included in a preference assessment should also be ecologically and culturally appropriate so that they will be delivered contingently as intended in the treatment environment.

Magnitude/Duration of Access Time

Stimulus magnitude affects preference assessment outcomes. *Magnitude* can include the amount (volume, quantity) of a stimulus or its duration of access. In an evaluation of magnitude with edible stimuli, Paden and Kodak (2015) found that each of four children with autism preferred large magnitude (2–3 edibles) over small magnitude reinforcers (1/8th of an edible) during concurrent choice trials with large and small magnitudes of preferred edibles preexperimentally determined to be eaten when presented alone. In an evaluation with nonedible stimuli, Trosclair-Lasserre et al. (2008) found that three of four children with autism referred for challenging behavior maintained by attention or access to tangible items selected larger (120 s) over smaller (10 s) magnitudes of social attention (or tangibles) when both were concurrently available. In addition, the larger magnitude consequence was a more efficacious reinforcer, producing more responses (i.e., higher breakpoint) in a subsequent PR arrangement.

Other researchers have found that preference for leisure stimuli depends on their magnitude. Steinhilber and Johnson (2007) conducted two conditions of MSWO preference assessments with two adolescents with autism. In one condition, selection responses resulted in 15-s access; in the other condition, selection responses resulted in 15-min access. Distinctly different preference hierarchies were found; stimuli that were most preferred with brief access were less preferred with extended access and stimuli that were most preferred with extended access were less preferred with brief access.

When planning a preference assessment, one should consider magnitude. In a preference assessment, the magnitude should be consistent across all assessed stimuli. For instance, in a preference assessment of edibles, similarly sized edibles should be used; in a preference assessment of social stimuli or tangible items, the same duration of access should be provided for each stimulus selection. Further, the duration of access to nonedible items in preference assessments should match the duration of access to reinforcers in the natural environment. Use short duration access, such as 15 s, in preference assessments to identify preferred stimuli to deliver contingently more frequently throughout the day such as after correct responses in discrete trial training; use longer duration access, such as 5 min, in preference assessments to identify stimuli to use contingently less often and after more effortful responses or chains of behavior.

Preference Stability and Motivating Operations

One of my most preferred things to do since I was a child is to spend the day at the beach. Mayflower and Long Point are two of my favorites, but I would not choose to go to either of them on a cold, rainy day. Preference assessments may yield different outcomes when repeated, suggesting that a highly efficacious reinforcer at one time might not be one at another time. Michael (1993) articulated that the behavioral principle of reinforcement alone does not explain the occurrence of behavior, that other environmental events alter reinforcing functions and that these environmental events must be included in an explanatory account of behavior.

Certain environmental events function as *motivating operations* by altering the reinforcing effect of a stimulus and the likelihood of behavior that has historically been reinforced by that stimulus (Laraway et al., 2003). Preexperimental manipulations of both the consumption of edibles (Gottschalk et al., 2000) and the availability of leisure items (Hanley et al., 2006) yielded different outcomes. *Satiation* is a motivating (abolishing) operation in which the reinforcing value of a stimulus is weakened; for example, edibles will be less reinforcing after a large meal than before one. *Deprivation* is the inverse motivating (establishing) operation in which the reinforcing value of a stimulus is strengthened; for example, gardening is more reinforcing in early spring after a long winter than in the summer.

Preference for some stimuli is less affected by motivating operations than others and this has been shown by repeating preference assessments across different intervals of time and seeing how consistent the results are. If the results are consistent across different administrations, then *preference stability* is demonstrated. Research on preference stability has indicated that top-ranked stimuli are more stable than lower-ranked stimuli (DeLeon & Iwata, 1996; Lee et al., 2010; Zhou et al., 2001), that preference for edibles is more stable than leisure or social stimuli (Butler & Graff, 2021), and that preference stability degrades over time (Butler & Graff, 2021; Ciccone et al., 2007). Butler and Graff (2021) assessed preference stability in four individuals with autism for edibles, leisure items, and social attention in monthly assessment administrations across 12 months. The greatest stability was seen in month-to-month assessments of edible stimuli, but preferences for leisure and social stimuli were also relatively stable from 1 month to the next. When the first and last preference assessment results were compared (i.e., 12 months apart), edible preferences continued to be stable, but preferences for social and leisure stimuli were markedly different. The implication of these results is that preference is not static and that preference assessments need to be conducted more often than annually to ensure that programming based on preference assessment results, particularly for social and leisure stimuli, will be effective.

One way that behavior analysts have proactively addressed preference shifts is by conducting frequent, brief preference assessments that can capture momentary fluctuations in stimulus preference (DeLeon et al., 2001); these brief assessments provide additional choice opportunities and perhaps more stimulus variation, both of which are often preferred by clients (Hanratty & Hanley, 2021).

Preference assessments should be conducted routinely to capture any shifts in preferences and ensure that the most preferred stimuli are incorporated into programming. Preference assessments for social and leisure stimuli should be conducted every few months, and for edible stimuli every 6–12 months. It is recommended, however, that more frequent brief assessments or choice opportunities with a few top-ranked items be conducted to avoid deleterious effects from undetected preference shifts and to provide the opportunity for increased stimulus variation. To minimize the influence of motivating operations on preference assessment outcomes, it is advisable to set up choice arrangements for edibles at a consistent time of day, not after meals (although see Bojak & Carr, 1999), and to withhold access to social and leisure stimuli for a period before presenting them in a choice arrangement. Assessment stimuli should be familiar to clients and clinicians should consider exposing the client to each item briefly before starting a preference assessment.

Validating Preference Assessment Outcomes

There are three measures related to the validity of the methods used in and the outcomes produced by preference assessments: social validity, reliability, and predictive validity.

Wolf (1978) defined *social validity* as the significance of the goals, appropriateness of the procedures, and the social importance of their outcomes (Wolf, 1978). Social validity is the extent to which the consumer or other community stakeholders such as parents and staff agree with the significance of the goals, appropriateness of the procedures, and social importance of the outcomes (Wolf, 1978). Direct measures of social validity can be taken by assessing individuals' preference for reinforcement parameters and then incorporating those preferences in their behavioral programming (Hanley, 2010). For example, using a concurrent-chains arrangement, Hanratty and Hanley (2021) found that most of their participants preferred varied reinforcers and choice opportunities to select a reinforcer from an array. Indirect measures of social validity can also be taken. At the end of their study, Castelluccio and Johnson (2019) surveyed clinical staff not involved in the research on identifying preferred break environments; clinical staff reported that the outcomes were beneficial and that they would incorporate the identified HP break environments into their clients' across-the-day programming.

The outcomes of preference assessment have also been evaluated for reliability. *Reliability* is a measure of consistency, or the extent to which the results can be reproduced given the same conditions (Sidman, 1960). The reliability of a direct preference assessment method is evaluated with test–retest measures in which the results from one administration are typically compared with the results from another administration of the same method with the same individual (Brown et al., 2011). Reliability of the identification of HP stimuli and of stimulus rankings have been assessed. Reliability of the HP stimulus (or the same stimuli that meet an established criterion of selection responses or duration of interaction) is assessed by comparing results across administrations to see if the same stimuli will be identified as preferred. Reliability of stimulus rankings is analyzed using statistical tests to determine the extent to which the obtained ranks for all assessed stimuli are comparable across administrations.

Kang et al. (2013) reviewed the stimulus preference assessment literature and concluded that paired stimulus and MSWO assessments yielded the most reliable outcomes. This finding was empirically supported by Verriden and Roscoe (2016); they compared the correspondence of assessment results across six administrations for six individuals with autism spectrum disorders or traumatic brain injury and found that the paired-stimulus and MSWO selection-based assessments had higher correspondence across administrations than forced-operant or response-restriction duration-based methods.

Predictive validity is a measure of the extent to which the outcomes of a method predict future behavior (Brown et al., 2011). Reinforcer assessments test if the preference assessment accurately predicted stimuli that would function as reinforcers (absolute reinforcement effect) or accurately predicted that more preferred stimuli would support more responding than less preferred stimuli (relative reinforcement effect). A reinforcer effect is demonstrated by a replicable increase in the frequency of a specified response as a function of the stimulus delivered contingently on its occurrence.

Assessments of Absolute Reinforcer Effect

An *absolute reinforcer effect* is shown when a replicable increase in the frequency of a specified response is shown when a particular stimulus is delivered contingent on that response compared to the frequency of the specified response when that stimulus is not included in the contingency.

Reinforcer assessments evaluating absolute reinforcer effect have used ABAB reversal designs in which the frequency of a response already in the participant's repertoire is measured in a baseline phase (A) during which the presumptive reinforcing stimulus is not delivered contingent on the response, and a reinforcement phase (B) where the presumptive reinforcing stimulus is delivered contingent on the response. If the response frequency is higher during reinforcement than baseline phases, the stimulus is a reinforcer, and the absolute reinforcer effect is the difference in response levels between baseline and reinforcement phases. Different consequential stimuli may produce different levels of responding and these levels can be compared to see which stimulus produced the largest increase from baseline levels; this stimulus is considered to have greater reinforcing value. Single-operant reinforcement assessments have typically shown that HP stimuli almost always function as reinforcers and lower preferred stimuli sometimes do (e.g., Lee et al., 2010; Roscoe et al., 1999).

Multielement reinforcer assessments have also been used to evaluate absolute reinforcer effects, in which responding with no contingent stimulus (baseline or control) and responding with one or more contingent stimuli such as the most preferred and possibly also a moderately and least preferred contingent stimulus (reinforcement conditions) are compared. Carr et al. (2000) used a multielement reinforcer assessment that yielded different absolute reinforcer effects for each assessed stimulus; further, the magnitude of these effects was shown to be roughly equivalent to each stimulus' rank order on a preference assessment, with the highest levels of responding with the most preferred, then moderately preferred, and the lowest level of responding with the least preferred stimulus.

A third method to evaluate absolute reinforcer efficacy is PR schedule arrangements (e.g., Roane et al., 2001), which systematically increase the response requirement to access the reinforcing stimulus until ratio strain is observed and responding stops. The last ratio schedule that produced responding is called the breakpoint; the breakpoint is an absolute value of the reinforcing efficacy of a stimulus, and the breakpoints of different stimuli can be compared. Morris and Vollmer (2020) found good correspondence in the rank ordering of stimuli via a stimulus preference assessment and the rank ordering of those same stimuli in a PR assessment for approximately half of eight children with autism, indicating that more highly preferred stimuli are more effective reinforcers and support more responses than less preferred stimuli.

Assessments of Relative Reinforcer Effect

Reinforcer assessments evaluating *relative reinforcing effects* demonstrate the effect of two or more reinforcement conditions at the same time, such as comparing the effects of two different stimuli contingent on responding. Relative reinforcer effects are often evaluated when a preference assessment identifies a hierarchy of stimuli to provide predictive validity for that hierarchy. For example, a reinforcer assessment might validate preference assessment results by showing that a HP stimulus produced more responding than a LP stimulus.

Assessments best suited to show relative reinforcer effects use choice arrangements, including concurrent schedule and concurrent-chains procedures. In a series of concurrent arrangements described earlier with three simultaneously available chairs (or squares), each with a differently ranked stimulus from previous a paired-stimulus preference assessment or no stimulus (control), Piazza et al. (1996) found that all four participants diagnosed with intellectual disabilities or autism and intellectual disabilities spent more time in the chair (or square) with highly ranked than medium or lowly ranked stimuli, with medium than lowly ranked stimuli, and more time in chair (or square) with any ranked stimulus than no stimulus (control). Glover et al. (2008) used concurrent FR and single and concurrent PR schedules in which different discriminative stimuli signaled the availability of high and low preference stimuli contingent on the same (FR) or systematically increasing (PR) response requirements. The task responses were individualized for the three participants with autism based on their educational goals. Results indicated that all three children responded more for the high than the low preference reinforcer in both the single and concurrent arrangements, and that responding continued to be allocated more to the high preference stimulus even when FR schedules were based on different PR break points and there were much higher response requirements for the high preference than the concurrently available low preference stimulus. These results support the validity of a preference hierarchy generated by preference assessments.

Concurrent-chains assessments have also validated preference assessment outcomes. Castelluccio and Johnson (2019) used a concurrent-chains arrangement to determine if responding would be allocated to work correlated with access to more preferred break environments than work correlated with access to less preferred break environment. Results showed that both adolescents with autism referred for challenging behavior maintained by escape from work demands selected the initial links associated with the more preferred break environment more often than a less preferred break environment or no break (control), a less preferred break more often than no break, and that they completed the associated tasks to access the break environment.

When to Conduct a Reinforcer Assessment

As reviewed in this chapter, stimulus preference assessments have good predictive validity, particularly paired stimulus and MSWO formats. Best research practices are to conduct a reinforcer assessment to validate the outcomes from a preference assessment, and there are robust findings that highly ranked stimuli function as reinforcers. In applied settings, reinforcer assessments may not be necessary except under certain conditions. When highly ranked stimuli are incorporated into behavioral programming their reinforcing effect can be observed with ongoing data collection practices. For instance, changing the contingent stimulus for a skill acquisition program based on a recent preference assessment might be followed by improved accuracy, or incorporating recently identified HP leisure or social stimuli into a noncontingent reinforcement program might produce lower levels of aggressive or self-injurious behavior.

Reinforcer assessments, however, should be conducted if ongoing data collection procedures do not capture any change in behavior when stimuli from recent preference assessments are incorporated into programming. These reinforcer assessments will allow the behavior analyst to determine if, in fact, these stimuli function as reinforcers. If they function as reinforcers in the reinforcer assessment, the behavior analyst should evaluate other variables such as prerequisite skills for the acquisition task or maintaining variables for challenging behavior. If preferred stimuli do not function as reinforcers in a reinforcer assessment, variables that may be contributing to faulty preference measures should be considered, including the type of preference assessment, selection response, and dependent measure; type and number of stimuli and magnitude or duration of their access; motivating operations; the individual's prerequisite skills and the ecological and cultural fit of the stimuli.

Summary

Providing choice opportunities and measuring preferences are important practices for behavior analysts and others providing services to clients with autism and other developmental disabilities. In fact, acknowledging the importance of clients' choices and fostering self-determination are integrated in the Behavior Analyst Certification Board (2020) Ethics Code for Behavior Analysts. And yet, in a survey of professionals (i.e., behavior analysts, special educators, teachers) working with individuals with autism or developmental disabilities in public schools or private agencies, only 70% of respondents reported that they ever offered choices to their clients or students (Graff & Karsten, 2012). The proportion of respondents who reported offering choices, however, was much higher for behavior analysts (96%) than for other professionals (Graff & Karsten, 2012).

Conducting preference assessments and incorporating preferences into clients' treatment goals and strategies are professional skills and practices embedded into the Behavior Analyst Certification Board (2017) BCBA Task List (5th edition) and (2022) BCBA Test Content Outline (6th edition). Despite the field's rich technology of assessment methods and robust research findings on the predictive validity of preference assessments and their utility in the education and treatment of individuals with autism and other developmental disabilities, systematic preference assessments are not used as widely as professional standards dictate. In a recent survey, nearly 10% of behavior analyst reported using indirect but not direct preference assessments and approximately 80% reported that time was an obstacle to conducting direct preference assessments.

In this chapter, choice and preference assessment procedures were reviewed to document their empirical support, provide practical step-by-step directions on their implementation (including a method that takes no more than 5 min to administer), highlight variables that affect their validity, and articulate considerations in determining the best practices for an individual client. Hopefully this information will be useful to behavior analysts and others who provide services in the education and treatment of children with autism and other related developmental disabilities and will increase the provision of choice opportunities and the assessment of preferences and their integration into treatment goals and procedures.

References

Atkinson, R. P., Jenson, W. R., Rovner, L., Van Cameron, S., Wagenen, L., & Petersen, B. P. (1984). Brief report: Validation of the autism reinforcer checklist for children. *Journal of Autism and Developmental Disorders, 14*, 429–433. https://doi.org/10.1007/bf02409833

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The rights of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Applied Behavior Analysis, 23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Behavior Analyst Certification Board (2017). *BCBA task list* (5th ed.). Author. Retrieved from https://www.bacb.com/wp-content/uploads/2020/08/BCBA-task-list-5th-ed-211019.pdf

Behavior Analyst Certification Board (2020). *Ethics code for behavior analysts*. Author. Retrieved from https://www.bacb.com/wp-content/uploads/2022/01/Ethics-Code-for-Behavior-Analysts-220316-2.pdf

Behavior Analyst Certification Board (2022). BCBA Test Content Outline (6th ed.). Author. Retrieved from https://www.bacb.com/wp-content/uploads/2022/01/BCBA-6th-Edition-Test-Content-Outline-230206-a.pdf

Bojak, S. L., & Carr, J. E. (1999). On the displacement of leisure items by food during multiple-stimulus preference assessments. *Journal of Applied Behavior Analysis, 32*(4), 515–518. https://doi.org/10.1901/jaba.1999.32-515

Brodhead, M. T., Abston, G. W., Mates, M., & Abel, E. A. (2016a). Further refinement of video-based brief multiple-stimulus without replacement preference assessments. *Journal of Applied Behavior Analysis, 50*(1), 170–175. https://doi.org/10.1002/jaba.358

Brodhead, M. T., Al-Dubayan, M. N., Mates, M., Abel, E. A., & Brouwers, L. (2016b). An evaluation of a brief video-based multiple-stimulus without replacement preference assessment. *Behavior Analysis in Practice, 9*(2), 160–164. https://doi.org/10.1007/s40617-015-0081-0

Brown, F., Lehr, D., & Snell, M. E. (2011). Conducting and using student assessment. In M. E. Snell & F. Brown (Eds.), *Instruction of students with severe disabilities* (pp. 73–120). Pearson.

Butler, C., & Graff, R. B. (2021). Stability of preference and reinforcing efficacy of edible, leisure, and social attention stimuli. *Journal of Applied Behavior Analysis, 54*(2), 684–699. https://doi.org/10.1002/jaba.807

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*(2), 353–357. https://doi.org/10.1901/jaba.2000.33-353

Castelluccio, N. T., & Johnson, C. (2019). Using stimulus preference assessments to identify preferred break environments. *Journal of Applied Behavior Analysis, 52*(3), 772–787. https://doi.org/10.1002/jaba.567

Catania, A. C. (2013). *Learning* (5th ed.). Sloan publishing.

Ciccone, F. S., Graff, R. B., & Ahearn, W. H. (2007). Long-term stability of edible preferences in individuals with developmental disabilities. *Behavioral Interventions, 22*(3), 223-228. https://doi.org/10.1002/bin.238

Clark, S. B., Call, N. A., Simmons, C. A., Scheithauer, M. C., Muething, C. S., & Parks, N. (2020). Effects of magnitude on the displacement of leisure items by edible items during preference assessments. *Behavior Modification, 44*(5), 727–745. https://doi.org/10.1177/0145445519843937

Clevenger, T. M., & Graff, R. B. (2005). Assessing object-to-picture and picture-to-object matching as prerequisite skills for pictorial preference assessments. *Journal of Applied Behavior Analysis, 38*(4), 543–547. https://doi.org/10.1901/jaba.2005.161-04

Cohen-Almeida, D., Graff, R. B., & Ahearn, W. H. (2000). A comparison of verbal and tangible stimulus preference assessments. *Journal of Applied Behavior Analysis, 33*(3), 329–334. https://doi.org/10.1901/jaba.2000.33-329

Conine, D. E., & Vollmer, T. R. (2019). Relative preferences for edible and leisure stimuli in children with autism. *Journal of Applied Behavior Analysis, 52*(2), 557–573. https://doi.org/10.1002/jaba.525

Conine, D. F., Morris, S. L., Kronfli, F. R., Slanzi, C. M., Petronelli, A. K., Kalick, L., & Vollmer, T. R. (2021). Comparing the results of one-session, two-session, and three-session MSWO preference assessments. *Journal of Applied Behavior Analysis*. Advance online publication. https://doi.org/10.1002/jaba.808

Conyers, C., Doole, A., Vause, T., Harapiak, S., Yu, D. C. T., & Martin, G. L. (2002). Predicting the relative efficacy of three presentation methods for assessing preference of persons with developmental disabilities. *Journal of Applied Behavior Analysis, 35*(1), 49–58. https://doi.org/10.1901/jaba.2002.35-49

Cote, C. A., Thompson, R. H., Hanley, G. P., & McKerchar, P. M. (2007). Teacher report and direct assessment of preferences for identifying reinforcers for young children. *Journal of Applied Behavior Analysis, 40*, 157–166. https://doi.org/10.1901/jaba.2007.177-05

Critchfield, T. S., & Kollins, S. H. (2001). Temporal discounting: Basic research and the analysis of socially important behavior. *Journal of Applied Behavior Analysis, 34*(1), 101–122.

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*(4), 519–533. https://doi.org/10.1901/jaba.1996.29-519

DeLeon, I. G., Iwata, B. A., & Roscoe, E. M. (1997). Displacement of leisure reinforcers by food during preference assessments. *Journal of Applied Behavior Analysis, 30*(3), 475–484. https://doi.org/10.1901/jaba.1997.30-475

DeLeon, I. G., Iwata, B. A., Conners, J., & Wallace, M. D. (1999). Examination of ambiguous stimulus preferences with duration-based measures. *Journal of Applied Behavior Analysis, 32*(1), 111–114. https://doi.org/10.1901/jaba.1999.32-111

DeLeon, I. G., Fisher, W. W., Catter, V. R., Maglieri, K., Herman, K., & Marhefka, J. (2001). Examination of relative reinforcement effects of stimuli identified through pretreatment and daily brief preference assessments. *Journal of Applied Behavior Analysis, 34*, 463–473. https://doi.org/10.1901/jaba.2001.34-463

DeLeon, I. G., Graff, R. B., Frank-Crawford, M. A., Rooker, G. W., & Bullock, C. E. (2014). Reinforcement arrangements for learners with autism spectrum disorder. In *Handbook of early intervention for autism spectrum disorders* (pp. 205–228). Springer.

Fahmie, T. A., Iwata, B. A., & Jann, K. E. (2015). Comparison of edible and leisure reinforcers. *Journal of Applied Behavior Analysis, 48*(2), 331–343. https://doi.org/10.1002/jaba.200

Favell, J. E., & Cannon, P. R. (1977). Evaluation of entertainment materials for severely retarded persons. *American Journal of Mental Deficiency, 81*(4), 357–361. Retrieved from https://search.proquest.com/scholarly-journals/evaluation-entertainment-materials-severely/docview/63962842/se-2?accountid=166077

Fisher, W., & Mazur, J. E. (1997). Basic and applied research on choice responding. *Journal of Applied Behavior Analysis, 30*(3), 387–410. https://doi.org/10.1901/jaba.1997.30-387

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491–498. https://doi.org/10.1901/jaba.1992.25-491

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment. *American Journal on Mental Retardation, 101*(1), 15–25. https://doi.org/10.1901/jaba.1996.29-1

Fisher, W. W., Thompson, R. H., Piazza, C. C., Crossland, K., & Gotjen, D. (1997). On the relative reinforcing effects of choice and differential consequences. *Journal of Applied Behavior Analysis, 30*(3), 423–438. https://doi.org/10.1901/jaba.1997.30-423

Fisher, W. W., Thompson, R. H., Hagopian, L. P., Bowman, L. G., & Krug, A. (2000). Facilitating tolerance of delayed reinforcement during functional communication training. *Behavior Modification, 24*(1), 3–29. https://doi.org/10.1177/0145445500241001

Geckeler, A. S., Libby, M. E., Graff, R. B., & Ahearn, W. H. (2000). Effects of reinforcer choice measured in single-operant and concurrent-schedule procedures. *Journal of Applied Behavior Analysis, 33*(3), 347–351. https://doi-org.wne.idm.oclc.org/10.1901/jaba.2000.33-347

Glover, A. C., Roane, H. S., Kadey, H. J., & Grow, L. L. (2008). Preference for reinforcers under progressive- and fixed-ratio schedules: A comparison of single and concurrent arrangements. *Journal of Applied Behavior Analysis, 41*(2), 163–176. https://doi.org/10.1901/jaba.2008.41-163

Gottschalk, J. M., Libby, M. E., & Graff, R. B. (2000). The effects of establishing operations on preference assessment outcomes. *Journal of Applied Behavior Analysis, 33*(1), 85–88. https://doi.org/10.1901/jaba.2000.33-85

Graff, R. B., & Gibson, L. (2003). Using pictures to assess reinforcers in individuals with developmental disabilities. *Behavior Modification, 27*, 470–483. https://doi.org/10.1177/0145445503255602

Graff, R. B., & Karsten, A. M. (2012). Assessing preferences of individuals with developmental disabilities: A survey of current practices. *Behavior Analysis in Practice, 5*(2), 37–48. https://doi.org/10.1007/BF03391822

Green, C. W., Reid, D. H., White, L. K., Halford, R. C., Brittain, D. P., & Gardner, S. M. (1988). Identifying reinforcers for persons with profound handicaps: Staff opinion versus systematic assessment of preferences. *Journal of Applied Behavior Analysis, 21*(1), 31–43. https://doi.org/10.1901/jaba.1988.21-31

Groskreutz, M. P., & Graff, R. B. (2009). Evaluating pictorial preference assessment: The effect of differential outcomes on preference assessment results. *Research in Autism Spectrum Disorders, 3*(1), 113–128. https://doi.org/10.1016/j.rasd.2008.04.007

Gureghian, D. L., Vladescu, J. C., Gashi, R., & Campanaro, A. (2020). Reinforcer choice as an antecedent versus consequence during skill acquisition. *Behavior Analysis in Practice, 13*(2), 462–466. https://doi.org/10.1007/s40617-019-00356-3

Hanley, G. P. (2010). Toward effective and preferred programming: A case for the objective measurement of social validity with recipients of behavior-change programs. *Behavior Analysis in Practice, 3*(1), 13–21. https://doi.org/10.1007/BF03391754

Hanley, G. P., Iwata, B. A., & Lindberg, J. S. (1999). Analysis of activity preferences as a function of differential consequences. *Journal of Applied Behavior Analysis, 32*(4), 419–435. https://doi.org/10.1901/jaba.1999.32-419

Hanley, G. P., Iwata, B. A., Lindberg, J. S., & Conners, J. (2003). Response-restriction analysis: I. Assessment of activity preferences. *Journal of Applied Behavior Analysis, 36*(1), 47–58. https://doi.org/10.1901/jaba.2003.36-47

Hanley, G. P., Piazza, C. C., Fisher, W. W., & Maglieri, K. A. (2005). On the effectiveness of and preference for punishment and extinction components of function-based interventions. *Journal of Applied Behavior Analysis, 38*(1), 51–65. https://doi.org/10.1901/jaba.2005.6-04

Hanley, G. P., Iwata, B. A., & Roscoe, E. R. (2006). Some determinants of changes in preference over time. *Journal of Applied Behavior Analysis, 39*(2), 189–202. https://doi.org/10.1901/jaba.2006.163-04

Hanratty, L. A., & Hanley, G. P. (2021). A preference analysis of reinforcer variation and choice. *Journal of Applied Behavior Analysis, 54*(3), 1062–1074. https://doi.org/10.1002/jaba.835

Heinicke, M. R., Carr, J. E., Pence, S. T., Zias, D. R., Valentino, A. L., & Falligant, J. M. (2016). Assessing the efficacy of pictorial preference assessments for children with developmental disabilities. *Journal of Applied Behavior Analysis, 49*(3), 848–868. https://doi.org/10.1002/jaba.342

Higbee, T. S., Carr, J. E., & Harrison, C. D. (1999). The effects of pictorial versus tangible stimuli in stimulus-preference assessments. *Research in Developmental Disabilities, 20*(1), 63–72. https://doi.org/10.1016/S0891-4222(98)00032-8

Higbee, T. S., Carr, J. E., & Harrison, C. D. (2000). Further evaluation of the multiple-stimulus preference assessment. *Research in Developmental Disabilities, 21*(1), 61–73. https://doi.org/10.1016/S0891-4222(99)00030-X

Ivancic, M. T., & Bailey, J. S. (1996). Current limits to reinforcer identification for some persons with profound multiple disabilities. *Research in Developmental Disabilities, 17*(1), 77–92. https://doi.org/10.1016/0891-4222(95)00038-0

Jerome, J., & Sturmey, P. (2008). Reinforcing efficacy of interactions with preferred and nonpreferred staff under progressive-ratio schedules. *Journal of Applied*

Behavior Analysis, 41(2), 221–225. https://doi.org/10.1901/jaba.2008.41-221

Johnson, C., & Graff, R. B. (2023). Stimulus preference assessments. In J. L. Matson (Ed.), *Handbook of applied behavior analysis: Integrating research into practice*. Springer, Cham. https://doi.org/10.1007/978-3-031-19964-6_21

Kang, S., O'Reilly, M. F., Fragale, C. L., Aguilar, J. M., Rispoli, M., & Lang, R. (2011). Evaluation of the rate of problem behavior maintained by different reinforcers across preference assessments. *Journal of Applied Behavior Analysis, 44*(4), 835–846. https://doi.org/10.1901/jaba.2011.44-835

Kang, S., O'Reilly, M., Lancioni, G., Falcomata, T. S., Sigafoos, J., & Xu, Z. (2013). Comparison of the predictive validity and consistency among preference assessment procedures: A review of the literature. *Research in Developmental Disabilities, 34*(4), 1125–1133. https://doi.org/10.1016/j.ridd.2012.12.021

Karsten, A. M., & Carr, J. E. (2009). The effects of differential reinforcement of unprompted responding on the skill acquisition of children with autism. *Journal of Applied Behavior Analysis, 42*(2), 327–334. https://doi.org/10.1901/jaba.2009.42-327

Kelly, M. A., Roscoe, E. M., Hanley, G. P., & Schlichenmeyer, K. (2014). Evaluation of assessment methods for identifying social reinforcers. *Journal of Applied Behavior Analysis, 47*(1), 113–135. https://doi.org/10.1002/jaba.107

Kenzer, A. L., & Bishop, M. R. (2011). Evaluating preference for familiar and novel stimuli across a large group of children with autism. *Research in Autism Spectrum Disorders, 5*(2), 819–825. https://doi.org/10.1016/j.rasd.2010.09.011

Knochel, A. E., Blair, K. C., & Sofarelli, R. (2020). Culturally focused classroom staff training to increase praise for students with Autism Spectrum Disorder in Ghana. *Journal of Positive Behavior Interventions, 23*(2), 1–12. https://doi.org/10.1177/1098300720929351

Kuhn, D., DeLeon, I. G., Terlonge, C., & Goysovich, R. (2006). Comparison of verbal preference assessments in the presence and absence of the actual stimuli. *Research in Developmental Disabilities, 27*, 645–656. https://doi.org/10.1016/j.ridd.2005.08.001

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*(3), 407–414. https://doi-org.wne.idm.oclc.org/10.1901/jaba.2003.36-407

Lee, M. S. H., Yu, C. T., Martin, T. L., & Martin, G. L. (2010). On the relation between reinforcer efficacy and preference. *Journal of Applied Behavior Analysis, 43*(1), 95–100. https://doi.org/10.1901/jaba.2010.43-95

Lerman, D. C., Iwata, B. A., Rainville, B., Adelinis, J. D., Crosland, K. & Kogan, J. (2013). Effects of reinforcement choice on task responding in individuals with developmental disabilities. *Journal of Applied Behavior Analysis, 30*(3), 411-422. https://doi.org/10.1901/jaba.1997.30-411

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16*(2), 191–206. https://doi.org/10.1007/BF03392623

Morris, S. L., & Vollmer, T. R. (2019). Assessing preference for types of social interaction. *Journal of Applied Behavior Analysis, 52*(4), 1064–1075. https://doi.org/10.1002/jaba.597

Morris, S. L., & Vollmer, T. R. (2020). Evaluating the stability, validity, and utility of hierarchies produced by the Social Interaction Preference Assessment. *Journal of Applied Behavior Analysis, 53*(1), 522–535. https://doi.org/10.1002/jaba.610

Northrup, J., George, T., Jones, K., Broussard, C., & Vollmer, T. R. (1996). A comparison of reinforcer assessment methods: The utility of verbal and pictorial choice procedures. *Journal of Applied Behavior Analysis, 29*, 201–212. https://doi.org/10.1901/jaba.1996.29-201

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis, 18*(3), 249–255. https://doi.org/10.1901/jaba.1985.18-249

Paden, A. R., & Kodak, T. (2015). The effects of reinforcement magnitude on skill acquisition for children with autism. *Journal of Applied Behavior Analysis, 48*(4), 924–929. https://doi.org/10.1002/jaba.239

Peterson, C., Lerman, D. C., & Nissan, M. A. (2016). Reinforcer choice as an antecedent versus consequence. *Journal of Applied Behavior Analysis, 49*(2), 286–293. https://doi.org/10.1002/jaba.284

Piazza, C. C., Fisher, W. W., Hagopian, L. P., Bowman, L. G., & Toole, L. (1996). Using a choice assessment to predict reinforcer effectiveness. *Journal of Applied Behavior Analysis, 29*(1), 1–9. https://doi-org.wne.idm.oclc.org/10.1901/jaba.1996.29-1

Richman, D. M., Barnard-Brak, L., Abby, L., & Grubb, L. (2016). Multiple-stimulus without replacement preference assessment: Reducing the number of sessions to identify preferred stimuli. *Journal of Developmental and Physical Disabilities, 28*(3), 469–477. https://doi.org/10.1007/s10882-016-9485-1

Roane, H. S., Vollmer, T. R., Ringdahl, J. E., & Marcus, B. A. (1998). Evaluation of a brief stimulus preference assessment. *Journal of Applied Behavior Analysis, 31*(4), 605–620. https://doi.org/10.1901/jaba.1998.31-605

Roane, H. S., Lerman, D. C., & Vorndran, R. M. (2001). Assessing reinforcers under progressive schedule requirements. *Journal of Applied Behavior Analysis, 34*(2), 145–167. https://doi.org/10.1901/jaba.2001.34-145

Roscoe, E. M., Iwata, B. A., & Kahng, S. (1999). Relative versus absolute reinforcement effects: Implications for preference assessments. *Journal of Applied Behavior Analysis, 32*(4), 479–493. https://doi.org/10.1901/jaba.1999.32-479

Rynders, J. E., & Friedlander, B. Z. (1972). Preferences in institutionalized severely retarded children for selected visual stimulus material presented as operant reinforcement. *American Journal of Mental Deficiency*. Retrieved from https://search.proquest.com/scholarly-journals/preferences-institutionalized-severely-retarded/docview/64294541/se-2?accountid=166077

Sidman, M. (1960/1988). *Tactics of scientific research: Evaluating experimental data in psychology*. Basic Books. Authors Cooperative (reprinted).

Sipila-Thomas, E. S., Foote, A. J., White, A. N., Melanson, I. J., & Broadhead, M. T. (2021). A replication of preference displacement research in children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 54*(1), 403–416. https://doi.org/10.1002/jaba.775

Snyder, K., Higbee, T. S., & Dayton, E. (2012). Preliminary investigation of a video-based stimulus preference assessment. *Journal of Applied Behavior Analysis, 45*(2), 413–418. https://doi.org/10.1901/jaba.2012.45-413

Steinhilber, J., & Johnson, C. (2007). The effects of brief and extended stimulus availability on preference. *Journal of Applied Behavior Analysis, 40*(4), 767–772. https://doi.org/10.1901/jaba.2007.767-772

Tessing, J. L., Napolitano, D. A., McAdam, D. B., DiCesare, A., & Axelrod, S. (2006). The effects of providing access to stimuli following choice making during vocal preference assessments. *Journal of Applied Behavior Analysis, 39*(4), 501–506. https://doi.org/10.1901/jaba.2006.56-05

Tiger, J. H., Hanley, G. P., & Hernandez, E. (2006). A further evaluation of the reinforcing value of choice. *Journal of Applied Behavior Analysis, 39*(1), 1–16. https://doi.org/10.1901/jaba.2006.158-04

Trosclair-Lasserre, N. M., Lerman, D. C., Call, N. A., Addison, L. R., & Kodak, T. (2008). Reinforcement magnitude: An evaluation of preference and reinforcer efficacy. *Journal of Applied Behavior Analysis, 41*(2), 203–220. https://doi.org/10.1901/jaba.2008.41-203

Verriden, A. L., & Roscoe, E. M. (2016). A comparison of preference-assessment methods. *Journal of Applied Behavior Analysis, 49*(2), 265–285. https://doi.org/10.1002/jaba.302

Virues-Ortega, J., Pritchard, K., Grant, R. L., North, S., Hurtado-Parrado, C., Lee, M. S. H., Temple, B., Julio, F., & Yu, C. T. (2014). Clinical decision making and preference assessment for individuals with intellectual and developmental disabilities. *American Journal on Intellectual and Developmental Disabilities, 119*(2), 151–170. https://doi.org/10.1352/1944-7558-119.2.151

Windsor, J., Piche, L. M., & Locke, P. A. (1994). Preference testing: A comparison of two presentation methods. *Research in Developmental Disabilities, 15*(6), 439–455. https://doi.org/10.1016/0891-4222(94)90028-0

Witryol, S. L., & Fischer, W. F. (1960). Scaling children's incentives by the method of paired comparisons. *Psychological Reports, 7*(3), 471–474. https://doi.org/10.2466/pr0.1960.7.3.471

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis, 35*(2), 287–290. https://doi.org/10.1901/jaba.1978.11-203

Worsdell, A. S., Iwata, B. A., & Wallace, M. D. (2002). Duration-based measures of preference for vocational tasks. *Journal of Applied Behavior Analysis, 35*(3), 287–290. https://doi.org/10.1901/jaba.2002.35-287

Zhou, L., Iwata, B. A., Goff, G. A., & Shore, B. A. (2001). Longitudinal analyses of leisure-item preferences. *Journal of Applied Behavior Analysis, 34*(2), 179–184. https://doi.org/10.1901/jaba.2001.34-179

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School-Based Interventions for Students with Autism

8

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Contents

Introduction

Estimates of the prevalence of autism have increased over the past several decades and the most recently available data suggests a prevalence of 1 in every 44 children (Maenner et al., 2021). The most recently available data from the Center for Disease Control (CDC) indicates that autism is currently the most prevalent and the most rapidly increasing subset of neurodevelopmental disorders in the general population. The increase in rates of autism diagnosis is believed to be a product of various factors including, but not limited to, ongoing changes in the diagnostic criteria (Fombonne, 2001; Schieve et al., 2012), improvements in the sensitivity and availability of established clinical tools and their use (Aiello et al., 2017), expanded and more consistent screenings in schools (Noland & Gabriels, 2004) and healthcare settings (Hyman et al., 2020), and a greater overall awareness of autism in the mainstream population (Gurney et al., 2003; King & Bearman, 2009). With respect to the diagnostic criteria for autism, the most recent revision represents the sixth such iteration since being introduced by Leo Kanner (Kanner, 1943; Saracino et al., 2010).

The increasing prevalence of autism in the general population has prompted various efforts to provide forms of Early and Intensive

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Behavioral Intervention (EIBI; Hyman et al., 2020), which has been found to support more positive outcomes for autistic learners (Eikeseth et al., 2012; Eldevik et al., 2009; Reichow et al., 2018). Aside from EIBI, which typically refers to intensive behavioral intervention with onset before primary school age (i.e., 0–5 years), these rising rates have also prompted various changes in school-based systems, services, and related policies as well (i.e., primary, secondary school settings; Cardinal et al., 2021; Pennington et al., 2014). Before reviewing school-based interventions and supports relevant to behavior analysts working with autistic students, we first discuss the differences between identifying individuals as meeting diagnostic criteria for autism (i.e., diagnosis of autism spectrum disorder) and eligibility for special education and related services under the special education category of "autism." The determination of whether an individual fits such criteria has significant implications regarding access to services, such as intervention based on applied behavior analysis or behavioral consultation delivered by a Board Certified Behavior Analyst (see Trump & Ayres, 2020, for a review related to medical coverage). Although both clinical and educational determinations each apply the label of "autism," the two methods differ in the specific criteria evaluated during the assessment process as well as the specific function of that assessment process, for example, determining authorization for service, access to individualized educational programming, educational and behavioral protections (Bowen Dahle, 2003). Each of these is discussed in greater detail in the sections below.

Educational Policies and Identification of Autism

Educational and clinical/medical systems each have distinct guidelines regarding diagnoses and recommendations for intervention for autism (Campbell et al., 2014; Hyman et al., 2020). Most readers are likely more familiar with the diagnostic procedures commonly observed in medical systems and other clinical settings. Specifically, this process refers to the mechanisms in place whereby an individual is referred to a trained clinical (e.g., psychologist) or medical provider (e.g., developmental pediatrician) for assessment to determine the presence or absence of traits or behaviors consistent with those demonstrated by autistic individuals. This model of diagnosis for autism, and subsequent treatment, is driven by the specific criteria listed in the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition (DSM-5; American Psychiatric Association, 2013). The criteria in the DSM-5 are worded broadly to capture the range of differences believed to be characteristic of the disorder, such as characteristic challenges in various social situations (e.g., initiating social, nonverbal social communication) as well as the presence of restricted or repetitive behaviors or interests that interfere with functioning in various contexts (American Psychiatric Association, 2013). Before moving further, we note that there is currently no single, shared behavioral or biological marker that assists in conclusively determining the presence or absence of autism (Shattuck et al., 2009). Despite the growing utilization of genetic screening as a complement to comprehensive development assessments (see Shafqat et al., 2022), the use of clinical symptoms remains the most common and the most reliable means of diagnosing the disorder and guiding the types and amount of services and interventions provided to families. Furthermore, it warrants highlighting that behavioral treatment in the United States (US) is traditionally contingent on some form of diagnosis and resulting coverage (Trump & Ayres, 2020). As such, this process of assessment serves to facilitate coverage and/or authorization for various clinical services to support autistic individuals (e.g., behavioral parent training, EIBI, medication management, therapy).

In contrast to identifying autistic individuals in clinical and medical settings, the process of identifying and serving *students* with differences consistent with autism is something modeled at the individual state level from federal legislation rather than the DSM-5 (Pennington et al., 2014). Broadly, criteria specific to the educational classification of autism are listed in the

Individuals with Disabilities Education Improvement Act (IDEIA; *Individuals with Disabilities Education Improvement Act*, 2004). These guidelines were also written generally, as a guide for individual states to follow and implement, though these are largely consistent with those used previously to capture the symptoms of both autism and pervasive developmental disorders more broadly.[1] However, despite some common language, we note that educational policies regarding identification differ from clinical guidelines for diagnosis in several ways.

The first way in which the DSM-5 and the educational guidelines differ is in terms of the specific criteria used to characterize symptoms and needs consistent with autism. For example, there is added verbiage in educational policy that students must have needs that "adversely affects a child's educational performance" to be eligible for special education supports, related services, and safeguards under this label (*Individuals with Disabilities Education Improvement Act*, 2004). Furthermore, educational policy holds that this label does not apply if educational performance is adversely affected due to an "emotional disturbance." Conditional language specific to educational performance means that students with a clinical diagnosis of autism based on the DSM-5 *may not* be eligible for special education supports and services if no educational impairments have been observed (Ramsey et al., 2016). For example, students described as having a "high-functioning" case of autism may excel in many or all academic subjects and instead face challenges associated with other issues that often co-occur with the disorder (e.g., anxiety). In such cases, those learners may or may not be determined eligible for special education. However, despite this possibility, it is estimated that approximately 80% of children diagnosed clinically with autism will also meet the criteria for eligibility for special education and/or related services under the educational label of autism (Wilkinson, 2016; Yeargin-Allsopp et al., 2003). As such, the increasing trends observed in the US population are echoed in the growing rates in the educational classification under "autism" as well (Cardinal et al., 2021).

The second way in which educational guidelines vary is in terms of the interpretation of federal guidelines. That is, the criteria outlined in IDEIA serve as a *model* for individual states, and as such, specific implementations of these policies can and do vary at the individual state level (Barton et al., 2016; Stahmer & Mandell, 2007). These federal guidelines set a minimum standard and states are free to meet or exceed this standard. Because of this flexibility, specific assessment practices can and will vary across educational systems across states and within individual educational systems in a given state. Given this variability, school-based practices related to autism are highly heterogeneous and differ substantially in terms of staffing and staff training (e.g., teachers with training supporting complex learners), clinical expertise in assessing autism (e.g., school psychologists with training in autism), building resources (e.g., access to mental health professionals, behavior analysts), educational curricula (i.e., curricula specific to autistic learners), and systems of intervention (i.e., universal systems of support; Aiello et al., 2017; Pierce & Tincani, 2007).

Educational Policies and School-Based Interventions for Autism

Similar to policies related to the identification of autism, we also review educational policy before discussing school-based intervention for autistic students. Briefly, the IDEIA is a grants statute that provides individual states with federal funding to support students with disabilities contingent on the provision of supports and services that meet a minimum set of standards. That is, funding for schools is contingent upon compliance with educational guidelines that correspond to the *types* of services provided as well as *how and where* those services are provided.

[1] We note here that the educational classification of autism was historically modeled from the broader diagnostic criteria for pervasive developmental disorders (PDD) included in the previous iteration of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR).

Specifically, state and local educational agencies must provide a Free and Appropriate Public Education (FAPE) to students receiving supports and services under the various disability categories listed in the IDEIA. That is, funding for schools is contingent upon providing services that are considered to be "appropriate" for the learner, their learning needs, and the broader categorical label (e.g., individualized, produces benefit; Stevenson & Correa, 2019). Despite simple language in this regard, we note that there has historically been considerable debate in the US regarding what manner of programming is "appropriate" for autistic learners in the school setting. For example, considerable litigation has taken plan to determine the degree to which programming for autistic learners should be directly linked to applied behavior analytic practices and established principles of behavior (e.g., Discrete Trial Training; Etscheidt, 2003). Furthermore, regardless of the specific program decided by the individualized educational program team, such programming, supports, and other educational considerations are to be provided at no cost to the family.

In addition to the types and amounts of services, schools are required to take steps to deliver programming in the Least Restrictive Environment (LRE) necessary for the student to make progress (Koegel et al., 2012; Simpson, 1993). Historically, the entirety of special education programming was provided in self-contained settings removed from the opportunities for learners with disabilities to interact with other same-aged peers. This phenomenon continues to be problematic for several reasons. First, placement in restrictive settings is significantly associated with learners that are minorized and/or living at or below the federal poverty threshold (see Kurth et al., 2016). That is, educational placement and opportunities to engage with the mainstream curriculum have historically not been equitable across learners. Second, removing learners from the natural learning environment has been linked to lower overall improvements in several aspects of social development compared to autistic learners that were supported in the mainstream curriculum (e.g., see Fisher & Meyer, 2002). That is, were schools to omit steps exploring support in the general education setting, this might remove opportunities for these learners to interact and socialize with their same-age neurotypical peers. Given these risks and opportunities for biases in educational placement decisions, schools are required to justify why a student (with or without autism) cannot make adequate progress alongside their same-age peers in general education settings (i.e., alongside same-age typically-developing peers; Alquraini, 2013).

Children eligible for special education may qualify for modifications to the general education curriculum (e.g., different academic goals, individualized method of delivery) and/or related supports and services to support their educational performance (e.g., speech and language therapy, individualized behavior programming). For example, modifications to the educational curriculum for autistic students may take the form of specialized methods of instruction and alternative methods of curriculum design (e.g., Discrete Trial Teaching; Stevenson & Correa, 2019). Additionally, students with autism may require specialized services to assist them in benefiting from their educational programming and/or supporting their interactions with others in their school and their local community. Related services may be necessary to support the development of various functional skills, such as socialization and/or functional communication, which are core characteristics of autism (see Nunes et al., 2021, for a relevant review). Furthermore, autistic individuals often present with other co-occurring challenges beyond those characteristic of the disorder, and specialized supports and services may be necessary to support students in these specific regards (Avni et al., 2018). For example, prior to the latest iteration of the DSM, issues associated with inattention and hyperactivity were considered to be resulting from the presence of autism and separate from Attention Deficit-Hyperactivity Disorder (ADHD; Joshi et al., 2010). Prior guidelines viewed diagnoses of both autism and ADHD as incompatible, and as a result, pharmacological and ecological interventions to address attention issues were historically underutilized in this population. Furthermore, various other mental health issues are historically less addressed in this population as well. A review by Adams et al. (2019) explored screening and support for autistic students presenting with anxiety and found that approaches for detecting and subsequently addressing symptoms of anxiety were underdeveloped for this population. Additionally, a review by Stewart et al. (2006) reviewed mental health screening and diagnosis in autism as well, but for depression. Similar to symptoms of anxiety, screening, detection, and intervention for autistic individuals struggling with symptoms of depression are also underdeveloped at this time.

Evidence-Based Interventions for Autism

Various research teams and professional organizations have explored how a range of methods and learning principles have been directed toward improving academic and behavioral outcomes for autistic individuals (National Autism Center, 2020; What Works Clearinghouse, 2016). In research conducted across various settings (e.g., schools and center-based programs), the levels of support for available practices and interventions have been found to vary (McDonald & DiGennaro Reed, 2018; Metz et al., 2005). That is, intervention approaches marketed to families and educators to support autistic individuals range from those that are not supported by research (e.g., "fad" therapies, pseudoscientific practices) to those with clear and consistent evidence of efficacy and effectiveness (McDonald & DiGennaro Reed, 2018; Travers et al., 2016). The available information suggests that unsupported treatment approaches are consumed by families of individuals diagnosed with autism at high rates (Goin-Kochel et al., 2007) and that this is also the case for educators practicing in school-based settings as well (Lilienfeld et al., 2012).

Before discussing evidence-based practices further, we first review the terms "efficacy" and "effectiveness" as these relate to support for specific interventions and treatment packages (for a discussion on evidence-based behavior analysis, see Smith et al., 2007). Efficacy refers to the degree to which some specific intervention or practice yields a consistent or replicable effect in idealized settings (e.g., clinic, research setting; Hunsley & Lee, 2007). For example, this might refer to the results of research performed with expert facilitators and resources (e.g., staffing, financial support) that exceed what is typically available in such settings. Alternatively, the term effectiveness refers to the degree to which such practices yield consistent and replicable effects in "real-world" contexts (e.g., schools; Hunsley & Lee, 2007). This manner of research is typically conducted in settings under real-world constraints (i.e., no extraneous resources made available) with community-based partners as the primary agent of change (i.e., not researchers or graduate students). As such, evidence of effectiveness is much more relevant when making recommendations for practice to school administrators, teachers, and other professionals working within public school settings. Additionally, we also note that the term evidence-based practices (EBPs), to behavior analysts, more closely refers to conventions and practices emerging from direct translations of established principles of behavior (Baer et al., 1968; Smith, 2013). This is a slightly different interpretation of EBPs when compared to school and clinical psychology, whereby a greater emphasis is placed on links to specific diagnosis and other structural descriptions (e.g., anxiety, depression).

A range of research teams, federally funded workgroups, and non-profit foundations continuously review the applied literature to appraise the presence, and strength, of evidence for specific intervention approaches in autism. Although not specific to school-aged individuals with autism, groups such as the National Autism Center (NAC; National Autism Center, 2020) and the National Professional Development Center on Autism Spectrum Disorders (NPDC; Waligórska et al., 2019) have synthesized the available evidence for various interventions and practices to guide families, clinicians, and those involved in the development of public policy. The results of these works are integrated into materials (e.g., parent guides, respective summaries of evidence) that are more easily disseminated to, and consumed by, non-professional audiences. Both the NAC and NPDC, and various others not noted here, generally serve to assist stakeholders in distinguishing packages and procedures that are well-established (i.e., good efficacy) or emerging/somewhat established (i.e., some efficacy) from those that are not established, have limited or questionable support, or are potentially dangerous (Chambless et al., 1998; Smith, 2013).

Respective reviews from the NAC and the NPDC indicated substantial overlap in the methods and practices believed to be supported by empirical research. As noted earlier, these reviews of the literature were not restricted to school-age autistic children nor implementations conducted in school-based settings. However, many of these approaches are not specific to the setting and are likely to be useful for a range of learners across settings and applications. For the NAC, the results from their review indicated good support for the following categories of behavioral intervention[2] in addressing the needs of autistic individuals: cognitive-behavioral intervention packages (i.e., cognitive-behavior therapy), comprehensive behavioral treatment packages/curricula for young autistic children (i.e., EIBI), language training, modeling of behavior, naturalistic teaching strategies, parent training packages, peer training packages, pivotal response treatments (e.g., pivotal response training), visual schedules, scripting, self-management, social skills packages, and story-based interventions. The NPDC also found good support for a similar range of intervention approaches for autistic learners. These included prompting, antecedent-based interventions, time delay procedures, reinforcement, task analysis, discrete trial training, functional behavior assessment, functional communication training, response interruption and redirection, differential reinforcement, social narratives, structured playgroups, video modeling, naturalistic interventions, peer-mediated interventions, pivotal response training, visual support, self-management, parent-implemented interventions, social skills training, scripting, technology-aided instruction, the Picture Exchange Communication System, and extinction. Although a considerable number of approaches and strategies have been determined to be well-supported in the literature by NAC and NPDC, a select range of ecological strategies, behavioral supports, and intervention practices are discussed in greater detail in the sections below.

[2]We note here that most summaries of the literature have generated categorical groupings rather than referencing specific intervention packages or discrete procedures. Although less precise, this approach serves to highlight the shared efficacy of approach based on similar ecological procedures.

Antecedent-Based Strategies

Both the NAC and NPDC found good support for the use of antecedent-based strategies to support academic and behavioral improvement for autistic individuals. Broadly, antecedent strategies manipulate the environment in such a way as to increase or decrease the likelihood that some behavior of interest occurs. For example, antecedent strategies have been used in academic and socialization contexts to support independent functioning as well as in more challenging contexts to reduce the likelihood of frustration or unsafe behavior. Beyond the specific examples listed in the NAC and NPDC, various other related reviews of antecedent behavior management strategies have also determined these approaches to be efficacious (see Crosland & Dunlap, 2012; de Bruin et al., 2013; Machalicek et al., 2007). Some examples of antecedent strategies commonly used with autistic learners include various levels of prompting (see Kern et al., 2006; Sterling-Turner & Jordan, 2007, for reviews), illustrating daily routines and transitions using visual schedules (Lequia et al., 2012), embedding various choice opportunities within and between routines in the day (Reutebuch et al., 2015), and behavioral momentum (Nevin, 1996). For a relevant example, such strategies often take the form of providing a means of advance notice regarding the possibility of potential events as well as planned transitions. Sometimes described as "priming" in school settings, reviews of such phenomena have been associated with lower rates of problematic behavior in subsequent transitions (see Schreibman et al., 2000) as well as in supporting social interactions with typical peers (see Zanolli & Daggett, 1996). Additionally, visual and tactile representations of the day's events can be presented to learners to help in anticipating expectations throughout the day (i.e., visual schedule). A review by Lequia et al. (2012) found that visual schedules, regardless of the formal properties of the visualization (e.g., line art, photographs, videos), demonstrated overall positive effects on behavior for autistic learners. Additionally, programming for the opportunity for learners to make choices has also been associated with a range of desirable effects (see Cannella et al., 2005; Kern et al., 1998; Tullis et al., 2011, for reviews). That is, providing learners with the opportunity to select instructional tasks, as well as how to complete those tasks, is often associated with lower levels of frustration and overall improved engagement. In a relevant example of how choice is emphasized in behavior, Hanley et al. (1997) provided learners with the choice to choose how they would prefer to reduce their unsafe and challenging behavior. Beyond this specific example, it warrants noting that choice and self-determination are valued in behavior analysis beyond the specific effects that these have on behavior (for a relevant discussion, see Bannerman et al., 1990). Lastly, behavioral momentum (i.e., high-probably response sequences) has been used as a metaphor for the tendency of compliance to carry forward from sequences of high-preference responses through to subsequent low-preference responses (for a review of theory, see Nevin, 1996). Cowan et al. (2017) reviewed the literature on the use of behavioral momentum with students with autism and the results of a meta-analysis indicated large-to-very large overall effects. In an example specific to autistic learners in school settings, Banda and Kubina Jr. (2009) applied a behavioral momentum approach to increase the rates of task initiation for low-preference math tasks.

Reinforcement-Based Strategies

Reinforcement-based strategies were strongly represented in the reviews conducted by both the NAC and NPDC. Overall, there was strong support for the use of contingent reinforcement and reinforcement systems to support both academic and behavioral improvements for autistic learners. Broadly, many of the specific approaches highlighted in these reviews were derived most directly from differential reinforcement, for example, Functional Communication Training (E. G. Carr & Durand, 1985; Tiger et al., 2008). That is, behavior is addressed by teaching a functionally equivalent replacement for unsafe behavior and then reducing and/or eliminating reinforcement for the unsafe behavior. Additionally, there is good support that noncontingent delivery of reinforcers associated with problem behavior is also effective in this regard (see J. E. Carr et al., 2009, for a review). In a representative school-based example of this approach, Noel and Getch (2016) evaluated the noncontingent delivery of reinforcers (e.g., attention) by afterschool staff and the results indicated that this approach was effective and could be implemented with high integrity despite a lack of implementer training in behavior management strategies (i.e., non-professional support staff). Although most often implemented using positive reinforcers (e.g., attention, access to preferred items), such approaches are also amenable to negative reinforcers (i.e., escape from task demands; Butler & Luiselli, 2007). In a relevant school-based demonstration of this approach, McComas et al. (2000) evaluated how addressing the establishing operation(s) for escape from academic tasks can be used to address escape-maintained problem behavior.

More broadly, the NAC and the NPDC found good support for the use of various practices based on reinforcement. Shaping, as defined here, refers to the reinforcement of successive approximations towards a terminal response in efforts to establish a range of self-care, academic, communicative, and/or socialization behavior. In an example related to self-care, Hodges et al. (2017) used shaping procedures to systematically increase the range of foods consumed by autistic learners toward a balanced and healthy diet. Additionally, the token economy is another well-known and recognized type of reinforcement-based strategy (see Matson & Boisjoli, 2009 for a review). In this approach, tokens (i.e., stimuli paired with the delivery of a terminal reinforcer) are earned and exchanged to produce access to terminal/backup reinforcers. Indeed, token economy systems are among the most supported and most common strategies integrated into classroom management systems (for a classroom-focused review, see Simonsen et al., 2008). Specific to autistic individuals and those with other developmental disabilities, there is considerable evidence that supports the use of these practices in a range of settings and with a range of target behavior. Matson and Boisjoli (2009) conducted a review of the school-based literature and found that token economy systems have been effective for improving a range of school-related behavior, such as studying, engagement, participation, in-seat behavior, task completion, social interaction with peers and adults, and feeding.

Supports for Mental Health/ Behavioral Disorders

In addition to challenges directly related to academic skills and learning, comprehensive assessment and intervention for autistic students also addresses the comorbid mental health challenges associated with the disorder. As noted earlier, several challenges considered to co-occur with autism include, but are not limited to, symptoms of anxiety (Adams et al., 2019), depression (Stewart et al., 2006), and ADHD (Skokauskas & Gallagher, 2012; Solomon et al., 2012). A brief discussion of common approaches for treating these challenges with school-aged autistic students is provided below.

Regarding interventions designed to address symptoms of anxiety, various treatment packages have been adapted for use with autistic individuals (Chalfant et al., 2007; Moskowitz et al., 2017). For example, Moskowitz et al. (2017) evaluated a multicomponent intervention package for autistic students with comorbid anxiety in a multiple baseline design. Their results indicated that an intervention package that included strategies from both positive behavior support and cognitive behavior therapy was effective at reducing both challenging behavior and anxiety. Aside from this specific demonstration, there is evidence that a range of efficacious treatment packages exists for treating anxiety in this population. These packages include but are not limited to Cool Kids (Chalfant et al., 2007) and the Multimodal Anxiety and Social Skills Intervention (White et al., 2010). Additionally, there is evidence that the Program for the Education and Enrichment of Relational Skills (PEERS; Laugeson et al., 2012) social skills intervention has been linked to reducing symptoms of social anxiety, despite not being explicitly designed for such purposes (McVey et al., 2016).

Although there is a range of interventions designed or adapted to treat symptoms of anxiety in autistic learners, there is considerably less research on treating symptoms of depression in this population. That is, the literature is far more limited in terms of research and intervention related to the treatment of depression in the autistic population (Menezes et al., 2018). In a relevant exemplar of this literature, Santomauro et al. (2016) conducted a pilot trial of a cognitive behavior therapy package designed to address depression in autistic individuals. The results of this trial found limited evidence of efficacy for using a cognitive behavior therapy package to address these symptoms. Interestingly, and similar to outcomes research for anxiety, research using the PEERS intervention to address limited social skills and peer relationships was linked to lower levels of depressive symptoms (Schiltz et al., 2018).

More recently, researchers and clinicians have worked to better understand how issues with inattention and hyperactivity may contribute to challenges for autistic individuals. There is evidence that suggests that individuals with autism and co-ocurring ADHD fare less well in social skill training interventions than individuals with autism alone. Indeed, there is evidence that intervention for this subgroup may need to more directly address the symptoms of ADHD to improve overall outcomes (Davis & Kollins, 2012). However, research on ADHD intervention specific to autistic learners is still emerging.

Considerations for Individual and Cultural Diversity

In addition to better aligning intervention practices with scientific evidence, there have been recent strides in behavior analysis towards incorporating aspects of individual culture into behavioral assessments and programming. In a relevant example of this approach, Neely et al. (2019) provided a preliminary demonstration of how behavior analysts can consult with teachers and students in a manner that better reflects individual, school, and community culture. That is, teacher consultation and recommendations for educational programming can be designed such that aspects of individual and family culture can be incorporated into the intervention approach (i.e., surface adaptions; e.g., bi-lingual prompting/instruction, materials available in the native language of students). Culturally-aware consultation and intervention with teachers can include information relevant to a student's values, preferences, and characteristics in the context of their culture (Fong et al., 2016). For behavior analysts, specifically, Fong et al. (2016) provided an outline for developing the cultural awareness of behavior analysts for both themselves as individuals and as those they support.

Ongoing attempts to deliver culturally-responsive forms of behavior analysis have explored the use of materials made available in the native language of individuals and their families, evaluations of culturally-relevant reinforcers, the identification of culturally-valued targets for intervention, the delivery of training in the native language of the client and family, and making attempts to match the clinicians to the birthplace, ethnicity, or gender of the client (Fong et al., 2016; Sivaraman & Fahmie, 2020). Additionally, further consideration of language exposure and culture has been helpful in better distinguishing between autistic English Language Learners (ELLs) and others presenting solely with characteristic differences in their social-communicative repertoires (see Dennison et al., 2019, for a discussion). In a relevant example, Dalmau et al. (2011) implemented an FCT intervention that targeted both the native language and English for autistic ELL learners to establish an initial communicative repertoire. However, despite emerging research in this area, additional research and training continue to be necessary for this domain.

Systems-Based Intervention Models and Multi-Disciplinary Collaboration

Behavior analysts supporting autistic individuals in school-based settings work alongside related service providers and within existing systems of support (i.e., those likely without expertise in behavior analysis). Multi-tiered systems of support were initially presented as a framework for preventing negative learning outcomes in early intervention (e.g., Simeonsson, 1991) and this approach has since been expanded to support both primary and secondary school settings. Specifically, school-wide systems of academic (i.e., Response-to-Intervention [RTI]) and behavior support (i.e., Positive Behavior Interventions and Support [PBIS]) are often in place to proactively allocate support to all students, on an as-needed basis (Sugai & Horner, 2002). With respect to PBIS and behavioral intervention, these systems target broad, general repertoires that support effective engagement with academic programming as well as desired patterns of behavior (e.g., positive stated expectations; Sugai et al., 2000). Behavior analysts providing individualized programming for autistic learners will typically program contingencies within the broader context of existing systems of support (see Boegli & Wasik, 1978, for an example of school-wide token economies).

System- and class-wide interventions are not designed specifically to support individual students; rather, universal supports typically consist of operationally defined behavior expectations (e.g., clearly defined school rules), programming related to teaching those types of behavior (e.g., classroom lessons to teach desired behavior), responding to instances where desired behavior occur (i.e., individual feedback), delivering token reinforcement contingent on desired behavior (i.e., token reinforcers), and ongoing adjustments to the system and reinforcers based on empirical data (see Sugai et al., 2000). In addition to systems-level programming, various other general systems are often put in place for individual classrooms, for example, the Good Behavior Game (GBG; Barrish et al., 1969). Interventions such as the GBG are effective for improving engagement and reducing disruptive behavior for general education students (Bowman-Perrott et al., 2016), with emerging evidence that autistic learners also benefit from classwide supports as well (Vargo & Brown, 2020).

Summary and Recommendations for Behavior Analysis

Behavior analysts continue to be well-suited to supporting autistic individuals across a range of home, school, and community settings. Regarding the school setting specifically, a range of methods and procedures performed by behavior analysts (e.g., antecedent-, reinforcer-based strategies) have been determined effective (see de Bruin et al., 2013; Machalicek et al., 2007, for reviews). However, behavior analytic practice and consultation in school settings require knowledge and experience working within the policies and systems in place in these setting systems. Indeed, educators are often tasked with balancing their obligations to state laws and policies with the recommendations of consultants and the available research. This is particularly problematic when existing policies may run counter to contemporary behavior science and the most up-to-date research.

Behavior analysts seeking to consult or work within school systems would benefit from formal coursework, training, and mentorship related to compliance with educational and special education law. Indeed, various states mandate that schools implement certain systems (e.g., RTI) and behavioral recommendations and programming while considering the legal obligations of educators. Additionally, certain forms of individualized programming (i.e., individual goals) are reflected in legal documents (i.e., Individual Education Plans [IEPs]) and the requirements for modifying such plans require consideration from that student's IEP team (e.g., families, teachers). Furthermore, schools are complex systems supported by a range of professionals. That is, behavior analysts working in schools need to be able to collaborate and consult effectively with non-behavior analytic professions (e.g., occupational therapists, speech pathologists). As such, formal training and practicum experiences are necessary to prepare behavior analysts to work effectively within these systems. Lastly, schools support an increasingly diverse range of students, and behavior analysts consulting in schools must be aware of, and appreciate, individual diversity in their practice.

References

Adams, D., Young, K., & Keen, D. (2019). Anxiety in children with autism at school: A systematic review. *Review Journal of Autism and Developmental Disorders, 6*(3), 274–288. https://doi.org/10.1007/s40489-019-00172-z

Aiello, R., Ruble, L., & Esler, A. (2017). National study of school psychologists' use of evidence-based assessment in autism spectrum disorder. *Journal of Applied School Psychology, 33*(1), 67–88. https://doi.org/10.1080/15377903.2016.1236307

Alquraini, T. A. (2013). An analysis of legal issues relating to the least restrictive environment standards. *Journal of Research in Special Educational Needs, 13*(2), 152–158. https://doi.org/10.1111/j.1471-3802.2011.01220.x

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Association Publishing.

Avni, E., Ben-Itzchak, E., & Zachor, D. A. (2018). The presence of comorbid ADHD and anxiety symptoms in autism spectrum disorder: Clinical presentation and predictors. *Frontiers in Psychiatry, 9*, 717. https://doi.org/10.3389/fpsyt.2018.00717

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis.

Journal of Applied Behavior Analysis, 1(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Banda, D. R., & Kubina, R. M., Jr. (2009). Increasing academic compliance with mathematics tasks using the high-preference strategy with a student with autism. *Preventing School Failure: Alternative Education for Children and Youth, 54*(2), 81–85. https://doi.org/10.1080/10459880903217564

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The rights of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Applied Behavior Analysis, 23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Barrish, H. H., Saunders, M., & Wolf, M. M. (1969). Good behavior game: Effects of individual contingencies for group consequences on disruptive behavior in a classroom. *Journal of Applied Behavior Analysis, 2*(2), 119–124. https://doi.org/10.1901/jaba.1969.2-119

Barton, E. E., Harris, B., Leech, N., Stiff, L., Choi, G., & Joel, T. (2016). An analysis of state autism educational assessment practices and requirements. *Journal of Autism and Developmental Disorders, 46*(3), 737–748. https://doi.org/10.1007/s10803-015-2589-0

Boegli, R. G., & Wasik, B. H. (1978). Use of the token economy system to intervene on a school-wide level. *Psychology in the Schools, 15*(1), 72–78. https://doi.org/10.1002/1520-6807(197801)15:1<72::AID-PITS2310150114>3.0.CO;2-Q

Bowen Dahle, K. (2003). The clinical and educational systems: Differences and similarities. *Focus on Autism and Other Developmental Disabilities, 18*(4), 238–247. https://doi.org/10.1177/10883576030180040501

Bowman-Perrott, L., Burke, M. D., Zaini, S., Zhang, N., & Vannest, K. (2016). Promoting positive behavior using the Good Behavior Game: A meta-analysis of single-case research. *Journal of Positive Behavior Interventions, 18*(3), 180–190.

Butler, L. R., & Luiselli, J. K. (2007). Escape-maintained problem behavior in a child with autism: Antecedent functional analysis and intervention evaluation of noncontingent escape and instructional fading. *Journal of Positive Behavior Interventions, 9*(4), 195–202. https://doi.org/10.1177/10983007070090040201

Campbell, J. M., Ruble, L. A., & Hammond, R. K. (2014). Comprehensive developmental assessment model. In L. A. Wilkinson (Ed.), *Autism spectrum disorder in children and adolescents: Evidence-based assessment and intervention in schools*. American Psychological Association.

Cannella, H. I., O'Reilly, M. F., & Lancioni, G. E. (2005). Choice and preference assessment research with people with severe to profound developmental disabilities: A review of the literature. *Research in Developmental Disabilities, 26*(1), 1–15. https://doi.org/10.1016/j.ridd.2004.01.006

Cardinal, D. N., Griffiths, A. J., Maupin, Z. D., & Fraumeni-McBride, J. (2021). An investigation of increased rates of autism in U.S. public schools. *Psychology in the Schools, 58*(1), 124–140. https://doi.org/10.1002/pits.22425

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*(2), 111–126. https://doi.org/10.1901/jaba.1985.18-111

Carr, J. E., Severtson, J. M., & Lepper, T. L. (2009). Noncontingent reinforcement is an empirically supported treatment for problem behavior exhibited by individuals with developmental disabilities. *Research in Developmental Disabilities, 30*(1), 44–57. https://doi.org/10.1016/j.ridd.2008.03.002

Chalfant, A. M., Rapee, R., & Carroll, L. (2007). Treating anxiety disorders in children with high functioning autism spectrum disorders: A controlled trial. *Journal of Autism and Developmental Disorders, 37*(10), 1842–1857. https://doi.org/10.1007/s10803-006-0318-4

Chambless, D. L., Baker, M. J., Baucom, D. H., Beutler, L. E., Calhoun, K. S., Crits-Christoph, P., Daiuto, A., DeRubeis, R., Detweiler, J., & Haaga, D. A. (1998). Update on empirically validated therapies, II. *The Clinical Psychologist, 51*(1), 3–16.

Cowan, R. J., Abel, L., & Candel, L. (2017). A meta-analysis of single-subject research on behavioral momentum to enhance success in students with autism. *Journal of Autism and Developmental Disorders, 47*(5), 1464–1477. https://doi.org/10.1007/s10803-017-3076-6

Crosland, K., & Dunlap, G. (2012). Effective strategies for the inclusion of children with autism in general education classrooms. *Behavior Modification, 36*(3), 251–269.

Dalmau, Y. C. P., Wacker, D. P., Harding, J. W., Berg, W. K., Schieltz, K. M., Lee, J. F., Breznican, G. P., & Kramer, A. R. (2011). A preliminary evaluation of functional communication training effectiveness and language preference when Spanish and English are manipulated. *Journal of Behavioral Education, 20*(4), 233–251.

Davis, N. O., & Kollins, S. H. (2012). Treatment for co-occurring attention deficit/hyperactivity disorder and autism spectrum disorder. *Neurotherapeutics, 9*(3), 518–530. https://doi.org/10.1007/s13311-012-0126-9

de Bruin, C. L., Deppeler, J. M., Moore, D. W., & Diamond, N. T. (2013). Public school–based interventions for adolescents and young adults with an autism spectrum disorder: A meta-analysis. *Review of Educational Research, 83*(4), 521–550. https://doi.org/10.3102/0034654313498621

Dennison, A., Hall, S. P., Leal, J., & Madres, D. A. (2019). ASD or ELL? Distinguishing differences in patterns of communication and behavior. *Contemporary School Psychology, 23*(1), 57–67.

Eikeseth, S., Klintwall, L., Jahr, E., & Karlsson, P. (2012). Outcome for children with autism receiving early and intensive behavioral intervention in mainstream preschool and kindergarten settings. *Research in Autism Spectrum Disorders, 6*(2), 829–835.

Eldevik, S., Hastings, R. P., Hughes, J. C., Jahr, E., Eikeseth, S., & Cross, S. (2009). Meta-analysis of early intensive behavioral intervention for children with autism. *Journal of Clinical Child & Adolescent Psychology, 38*(3), 439–450.

Etscheidt, S. (2003). An analysis of legal hearings and cases related to individualized education programs for children with autism. *Research and Practice for Persons with Severe Disabilities, 28*(2), 51–69. https://doi.org/10.2511/rpsd.28.2.51

Fisher, M., & Meyer, L. H. (2002). Development and social competence after two years for students enrolled in inclusive and self-contained educational programs. *Research and Practice for Persons with Severe Disabilities, 27*(3), 165–174. https://doi.org/10.2511/rpsd.27.3.165

Fombonne, E. (2001). Is there an epidemic of autism? *Pediatrics, 107*(2), 411–412. https://doi.org/10.1542/peds.107.2.411

Fong, E. H., Catagnus, R. M., Brodhead, M. T., Quigley, S., & Field, S. (2016). Developing the cultural awareness skills of behavior analysts. *Behavior Analysis in Practice, 9*(1), 84–94.

Goin-Kochel, R. P., Myers, B. J., & Mackintosh, V. H. (2007). Parental reports on the use of treatments and therapies for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*(3), 195–209. https://doi.org/10.1016/j.rasd.2006.08.006

Gurney, J. G., Fritz, M. S., Ness, K. K., Sievers, P., Newschaffer, C. J., & Shapiro, E. G. (2003). Analysis of prevalence trends of autism spectrum disorder in Minnesota. *Archives of Pediatrics & Adolescent Medicine, 157*(7), 622–627. https://doi.org/10.1001/archpedi.157.7.622

Hanley, G. P., Piazza, C. C., Fisher, W. W., Contrucci, S. A., & Maglieri, K. A. (1997). Evaluation of client preference for function-based treatment packages. *Journal of Applied Behavior Analysis, 30*(3), 459–473. https://doi.org/10.1901/jaba.1997.30-459

Hodges, A., Davis, T., Crandall, M., Phipps, L., & Weston, R. (2017). Using shaping to increase foods consumed by children with autism. *Journal of Autism and Developmental Disorders, 47*(8), 2471–2479. https://doi.org/10.1007/s10803-017-3160-y

Hunsley, J., & Lee, C. M. (2007). Informed benchmarks for psychological treatments: Efficacy studies, effectiveness studies, and beyond. *Professional Psychology: Research and Practice, 38*(1), 21. https://doi.org/10.1037/0735-7028.38.1.21

Hyman, S. L., Levy, S. E., Myers, S. M., & Council on Children with Disabilities, Section on Developmental and Behavioral Pediatrics. (2020). Identification, evaluation, and management of children with Autism spectrum disorder. *Pediatrics, 145*(1), e20193447. https://doi.org/10.1542/peds.2019-3447

Individuals with Disabilities Education Improvement Act. (2004). https://search.library.wisc.edu/catalog/9993540093602122

Joshi, G., Petty, C., Wozniak, J., Henin, A., Fried, R., Galdo, M., Kotarski, M., Walls, S., & Biederman, J. (2010). The heavy burden of psychiatric comorbidity in youth with autism spectrum disorders: A large comparative study of a psychiatrically referred population. *Journal of Autism and Developmental Disorders, 40*(11), 1361–1370. https://doi.org/10.1007/s10803-010-0996-9

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*(3), 217–250.

Kern, L., Vorndran, C. M., Hilt, A., Ringdahl, J. E., Adelman, B. E., & Dunlap, G. (1998). Choice as an intervention to improve behavior: A review of the literature. *Journal of Behavioral Education, 8*(2), 151–169. https://doi.org/10.1023/A:1022831507077

Kern, L., Sokol, N., & Dunlap, G. (2006). Assessment of antecedent influences on challenging behavior. In J. K. Luiselli (Ed.), *Antecedent intervention: Recent developments in community focused behavior support* (pp. 53–71). Brookes.

King, M., & Bearman, P. (2009). Diagnostic change and the increased prevalence of autism. *International Journal of Epidemiology, 38*(5), 1224–1234. https://doi.org/10.1093/ije/dyp261

Koegel, L., Matos-Freden, R., Lang, R., & Koegel, R. (2012). Interventions for children with autism spectrum disorders in inclusive school settings. *Cognitive and Behavioral Practice, 19*(3), 401–412. https://doi.org/10.1016/j.cbpra.2010.11.003

Kurth, J. A., Mastergeorge, A. M., & Paschall, K. (2016). Economic and demographic factors impacting placement of students with autism. *Education and Training in Autism and Developmental Disabilities, 51*(1), 3–12.

Laugeson, E. A., Frankel, F., Gantman, A., Dillon, A. R., & Mogil, C. (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS program. *Journal of Autism and Developmental Disorders, 42*(6), 1025–1036. https://doi.org/10.1007/s10803-011-1339-1

Lequia, J., Machalicek, W., & Rispoli, M. J. (2012). Effects of activity schedules on challenging behavior exhibited in children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 6*(1), 480–492. https://doi.org/10.1016/j.rasd.2011.07.008

Lilienfeld, S. O., Ammirati, R., & David, M. (2012). Distinguishing science from pseudoscience in school psychology: Science and scientific thinking as safeguards against human error. *Journal of School Psychology, 50*(1), 7–36. https://doi.org/10.1016/j.jsp.2011.09.006

Machalicek, W., O'Reilly, M. F., Beretvas, N., Sigafoos, J., & Lancioni, G. E. (2007). A review of interventions to reduce challenging behavior in school settings for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*(3), 229–246. https://doi.org/10.1016/j.rasd.2006.10.005

Maenner, M. J., Shaw, K. A., Bakian, A. V., Bilder, D. A., Durkin, M. S., Esler, A., Furnier, S. M., Hallas, L., Hall-Lande, J., & Hudson, A. (2021). Prevalence and characteristics of autism spectrum disorder among children aged 8 years—Autism and developmental disabilities monitoring network, 11 sites, United States, 2018. *MMWR Surveillance Summaries, 70*(11), 1–16.

Matson, J. L., & Boisjoli, J. A. (2009). The token economy for children with intellectual disability and/or autism: A review. *Research in Developmental Disabilities, 30*(2), 240–248. https://doi.org/10.1016/j.ridd.2008.04.001

McComas, J., Hoch, H., Paone, D., & El-Roy, D. (2000). Escape behavior during academic tasks: A preliminary analysis of idiosyncratic establishing operations. *Journal of Applied Behavior Analysis, 33*(4), 479–493. https://doi.org/10.1901/jaba.2000.33-479

McDonald, M. E., & DiGennaro Reed, F. D. (2018). Distinguishing science and pseudoscience in the assessment and treatment of autism spectrum disorder. In S. Goldstein & S. Ozonoff (Eds.), *Assessment of autism spectrum disorder* (pp. 415–441). The Guilford Press.

McVey, A. J., Dolan, B. K., Willar, K. S., Pleiss, S., Karst, J. S., Casnar, C. L., Caiozzo, C., Vogt, E. M., Gordon, N. S., & Van Hecke, A. V. (2016). A replication and extension of the PEERS® for Young adults social skills intervention: Examining effects on social skills and social anxiety in Young adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*(12), 3739–3754. https://doi.org/10.1007/s10803-016-2911-5

Menezes, M., Robinson, L., Sanchez, M. J., & Cook, B. (2018). Depression in youth with autism spectrum disorders: A systematic review of studies published between 2012 and 2016. *Review Journal of Autism and Developmental Disorders, 5*(4), 370–389. https://doi.org/10.1007/s40489-018-0146-4

Metz, B., Mulick, J. A., & Butter, E. M. (2005). Autism: A late-20th-century fad magnet. In J. W. Jacobson, R. M. Foxx, & J. A. Mulick (Eds.), *Controversial therapies for developmental disabilities: Fad, fashion and science in professional practice* (pp. 237–263). Lawrence Erlaum Associates.

Moskowitz, L. J., Walsh, C. E., Mulder, E., McLaughlin, D. M., Hajcak, G., Carr, E. G., & Zarcone, J. R. (2017). Intervention for anxiety and problem behavior in children with autism spectrum disorder and intellectual disability. *Journal of Autism and Developmental Disorders, 47*(12), 3930–3948. https://doi.org/10.1007/s10803-017-3070-z

National Autism Center. (2020). *Findings and conclusions: National standards project, Phase 2*. https://www.nationalautismcenter.org/national-standards-project/phase-2/

Neely, L., Gann, C., Castro-Villarreal, F., & Villarreal, V. (2019). Preliminary findings of culturally responsive consultation with educators. *Behavior Analysis in Practice, 13*(1), 270–281.

Nevin, J. A. (1996). The momentum of compliance. *Journal of Applied Behavior Analysis, 29*(4), 535–547. https://doi.org/10.1901/jaba.1996.29-535

Noel, C. R., & Getch, Y. Q. (2016). Noncontingent reinforcement in after-school settings to decrease classroom disruptive behavior for students with autism spectrum disorder. *Behavior Analysis in Practice, 9*(3), 261–265. https://doi.org/10.1007/s40617-016-0117-0

Noland, R. M., & Gabriels, R. L. (2004). Screening and identifying children with autism spectrum disorders in the public school system: The development of a model process. *Journal of Autism and Developmental Disorders, 34*(3), 265–277. https://doi.org/10.1023/B:JADD.0000029549.84385.44

Nunes, D. R. P., Barbosa, J. P. S., & Nunes, L. R. P. (2021). Alternative communication for students with autism at school: A literature review. *Revista Brasileira de Educação Especial, 27*, 673–688. https://doi.org/10.1590/1980-54702021v27e0212

Pennington, M. L., Cullinan, D., & Southern, L. B. (2014). Defining autism: Variability in state education agency definitions of and evaluations for autism spectrum disorders. *Autism Research and Treatment, 2014*, e327271. https://doi.org/10.1155/2014/327271

Pierce, T., & Tincani, M. (2007). Beyond consumer advocacy: Autism spectrum disorders, effective instruction, and public schools. *Intervention in School and Clinic, 43*(1), 47–51. https://doi.org/10.1177/10534512070430010601

Ramsey, E., Kelly-Vance, L., Allen, J. A., Rosol, O., & Yoerger, M. (2016). Autism spectrum disorder prevalence rates in the United States: Methodologies, challenges, and implications for individual states. *Journal of Developmental and Physical Disabilities, 28*(6), 803–820. https://doi.org/10.1007/s10882-016-9510-4

Reichow, B., Hume, K., Barton, E. E., & Boyd, B. A. (2018). Early intensive behavioral intervention (EIBI) for young children with autism spectrum disorders (ASD). *Campbell Systematic Reviews*, (5), CD009260.

Reutebuch, C. K., El Zein, F., & Roberts, G. J. (2015). A systematic review of the effects of choice on academic outcomes for students with autism spectrum disorder. *Research in Autism Spectrum Disorders, 20*, 1–16. https://doi.org/10.1016/j.rasd.2015.08.002

Santomauro, D., Sheffield, J., & Sofronoff, K. (2016). Depression in adolescents with ASD: A pilot RCT of a group intervention. *Journal of Autism and Developmental Disorders, 46*(2), 572–588. https://doi.org/10.1007/s10803-015-2605-4

Saracino, J., Noseworthy, J., Steiman, M., Reisinger, L., & Fombonne, E. (2010). Diagnostic and assessment issues in autism surveillance and prevalence. *Journal of Developmental and Physical Disabilities, 22*(4), 317–330. https://doi.org/10.1007/s10882-010-9205-1

Schieve, L. A., Rice, C., Yeargin-Allsopp, M., Boyle, C. A., Kogan, M. D., Drews, C., & Devine, O. (2012). Parent-reported prevalence of autism spectrum disorders in US-born children: An assessment of changes within birth cohorts from the 2003 to the 2007 National Survey of Children's Health. *Maternal and Child Health Journal, 16*(1), 151–157. https://doi.org/10.1007/s10995-012-1004-0

Schiltz, H. K., McVey, A. J., Dolan, B. K., Willar, K. S., Pleiss, S., Karst, J. S., Carson, A. M., Caiozzo, C., Vogt, E. M., Yund, B. D., & Van Hecke, A. V. (2018). Changes in depressive symptoms among adolescents with ASD completing the PEERS® social skills intervention. *Journal of Autism and Developmental Disorders, 48*(3), 834–843. https://doi.org/10.1007/s10803-017-3396-6

Schreibman, L., Whalen, C., & Stahmer, A. C. (2000). The use of video priming to reduce disruptive transition behavior in children with autism. *Journal of Positive Behavior Interventions, 2*(1), 3–11. https://doi.org/10.1177/109830070000200102

Shafqat, I., Rosenau, K. A., & Martinez-Agosto, J. A. (2022). The role of genetic testing among autistic individuals. *Pediatrics, 149*(Supplement 4), e2020049437L. https://doi.org/10.1542/peds.2020-049437L

Shattuck, P. T., Durkin, M., Maenner, M., Newschaffer, C., Mandell, D. S., Wiggins, L., Lee, L.-C., Rice, C., Giarelli, E., Kirby, R., Baio, J., Pinto-Martin, J., & Cuniff, C. (2009). The timing of identification among children with an autism spectrum disorder: Findings from a population-based surveillance study. *Journal of the American Academy of Child and Adolescent Psychiatry, 48*(5), 474–483. https://doi.org/10.1097/CHI.0b013e31819b3848

Simeonsson, R. J. (1991). Primary, secondary, and tertiary prevention in early intervention. *Journal of Early Intervention, 15*(2), 124–134. https://doi.org/10.1177/105381519101500202

Simonsen, B., Fairbanks, S., Briesch, A., Myers, D., & Sugai, G. (2008). Evidence-based practices in classroom management: Considerations for research to practice. *Education and Treatment of Children, 31*(3), 351–380.

Simpson, R. (1993). Legal bases of interpreting the least restrictive environment for students with autism. *Focus on Autistic Behavior, 8*(4), 12–15.

Sivaraman, M., & Fahmie, T. A. (2020). A systematic review of cultural adaptations in the global application of ABA-based telehealth services. *Journal of Applied Behavior Analysis, 53*(4), 1838–1855. https://doi.org/10.1002/jaba.763

Skokauskas, N., & Gallagher, L. (2012). Mental health aspects of autistic spectrum disorders in children: Mental health aspects of ASD. *Journal of Intellectual Disability Research, 56*(3), 248–257. https://doi.org/10.1111/j.1365-2788.2011.01423.x

Smith, T. (2013). What is evidence-based behavior analysis? *The Behavior Analyst, 36*(1), 7–33.

Smith, T., Scahill, L., Dawson, G., Guthrie, D., Lord, C., Odom, S., Rogers, S., & Wagner, A. (2007). Designing research studies on psychosocial interventions in autism. *Journal of Autism and Developmental Disorders, 37*(2), 354–366. https://doi.org/10.1007/s10803-006-0173-3

Solomon, M., Miller, M., Taylor, S. L., Hinshaw, S. P., & Carter, C. S. (2012). Autism symptoms and internalizing psychopathology in girls and boys with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(1), 48–59. https://doi.org/10.1007/s10803-011-1215-z

Stahmer, A. C., & Mandell, D. S. (2007). State infant/toddler program policies for eligibility and services provision for young children with autism. *Administration and Policy in Mental Health and Mental Health Services Research, 34*(1), 29–37.

Sterling-Turner, H. E., & Jordan, S. S. (2007). Interventions addressing transition difficulties for individuals with autism. *Psychology in the Schools, 44*(7), 681–690. https://doi.org/10.1002/pits.20257

Stevenson, B. S., & Correa, V. I. (2019). Applied behavior analysis, students with autism, and the requirement to provide a free appropriate public education. *Journal of Disability Policy Studies, 29*(4), 206–215. https://doi.org/10.1177/1044207318799644

Stewart, M. E., Barnard, L., Pearson, J., Hasan, R., & O'Brien, G. (2006). Presentation of depression in autism and Asperger syndrome: A review. *Autism, 10*(1), 103–116. https://doi.org/10.1177/1362361306062013

Sugai, G., & Horner, R. (2002). The evolution of discipline practices: School-wide positive behavior supports. *Child & Family Behavior Therapy, 24*(1–2), 23–50. https://doi.org/10.1300/J019v24n01_03

Sugai, G., Horner, R. H., Dunlap, G., Hieneman, M., Lewis, T. J., Nelson, C. M., Scott, T., Liaupsin, C., Sailor, W., Turnbull, A. P., Turnbull, H. R., III, Wickham, D., Wilcox, B., & Ruef, M. (2000). Applying positive behavior support and functional behavioral assessment in schools. *Journal of Positive Behavior Interventions, 2*(3), 131–143. https://doi.org/10.1177/109830070000200302

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*(1), 16–23. https://doi.org/10.1007/BF03391716

Travers, J. C., Ayers, K., Simpson, R. L., & Crutchfield, S. (2016). Early intervention for young children with autism spectrum disorder. In R. Lang, T. Hancock, & N. Singh (Eds.), *Fad, pseudoscientific, and controversial interventions* (pp. 257–293). Springer.

Trump, C. E., & Ayres, K. M. (2020). Autism, insurance, and discrimination: The effect of an autism diagnosis on behavior-analytic services. *Behavior Analysis in Practice, 13*(1), 282–289. https://doi.org/10.1007/s40617-018-00327-0

Tullis, C. A., Cannella-Malone, H. I., Basbigill, A. R., Yeager, A., Fleming, C. V., Payne, D., & Wu, P.-F. (2011). Review of the choice and preference assessment literature for individuals with severe to profound disabilities. *Education and Training in Autism and Developmental Disabilities, 46*(4), 576–595.

Vargo, K., & Brown, C. (2020). An evaluation of and preference for variations of the Good Behavior Game with students with autism. *Behavioral Interventions, 35*(4), 560–570. https://doi.org/10.1002/bin.1740

Waligórska, A., Kucharczyk, S., Waligórski, M., Kuncewicz-Sosnowska, K., Kalisz, K., & Odom, S. L. (2019). National Professional Development Center on Autism Spectrum Disorders (NPDC) model—An integrated model of evidence-based practices for autism spectrum disorder. *Psychiatria Polska, 53*(4), 753–770. https://doi.org/10.12740/PP/99163

What Works Clearinghouse. (2016). U.S. Department of Education.

White, S. W., Albano, A. M., Johnson, C. R., Kasari, C., Ollendick, T., Klin, A., Oswald, D., & Scahill, L. (2010). Development of a cognitive-behavioral intervention program to treat anxiety and social deficits in teens with high-functioning autism. *Clinical Child and Family Psychology Review, 13*(1), 77–90. https://doi.org/10.1007/s10567-009-0062-3

Wilkinson, L. A. (2016). *A best practice guide to assessment and intervention for autism spectrum disorder in schools* (2nd ed.). Jessica Kingsley Publishers.

Yeargin-Allsopp, M., Rice, C., Karapurkar, T., Doernberg, N., Boyle, C., & Murphy, C. (2003). Prevalence of autism in a US metropolitan area. *JAMA, 289*(1), 49–55. https://doi.org/10.1001/jama.289.1.49

Zanolli, K., & Daggett, J. (1996). The effects of reinforcement rate on the spontaneous social initiations of socially withdrawn preschoolers. *Journal of Applied Behavior Analysis, 31*(1), 117–125.

9 Communication Assessment and Intervention

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Introduction

Autism is associated with significant and persistent delays in speech and language development and a range of social and communication impairments (Bal et al., 2020; Brigido et al., 2021). In fact, communication impairment is one of the defining characteristics of autism (American Psychiatric Association, 2013). Delayed speech and language development and impaired communicative functioning are key reasons why children are referred for diagnostic assessment and early intervention (Monteiro et al., 2019; Pierce et al., 2021).

Considering the recognized difficulties in this domain, communication assessment and intervention are critical areas of need for many children with autism. Fuentes et al. (2021) argued that assessment and intervention should aim to "address the specific social, communication, and behavioural challenges of autism" (p. 972). They further noted that assessment and intervention practices should be based on research and expert guidance. From a survey completed by 90 parents of children with autism, Pituch et al. (2011) found that many of these parents had treatment priorities that focused on developing their child's communication skills. Specific priority skills included teaching the child to (a) express wants and needs, (b) describe feelings, (c) initiate conversation, and (d) respond appropriately to questions. Implementation of effective intervention to improve daily functioning—which will generally require good social and communicative skills—has also been identified as an important research priority by various autism stakeholder groups (Roche et al., 2021).

This chapter reviews the literature related to the provision of communication assessment and intervention to children with autism. Assessment and intervention approaches derived from the principles of applied behavior analysis (ABA) are the main foci of this chapter because such approaches have strong empirical support and a long history of success in educating children with autism (Fuentes et al., 2021; Hume et al., 2021; National Autism Center, 2015; Schreibman et al., 2015). This chapter represents an updated version of the communication chapter (Chap. 6) by Sigafoos et al. that appeared in the previous (2009) edition of the current work.

In the present update, we first describe the nature and types of communication impairments associated with autism. We then review several widely used communication assessment protocols derived from ABA research. The protocols reviewed are consistent with the conceptualization of communication as learned/operant behavior that serves distinct functions or purposes (Skinner, 1957). Following this, we highlight some of the key features of ABA and generic ABA-based instructional tactics as these relate to communication intervention for children with autism. Three trends that have gained prominence in the field since the previous version of this chapter was published in 2009 are considered. These trends are (a) naturalistic teaching approaches, (b) prelinguistic interventions, and (c) the use of visual strategies to enhance the communicative functioning of children with autism.

Communication Impairment in Children with Autism

Children with autism can present with varying types and severity of communication impairment. Many children with autism experience delayed speech onset and atypical language (Barbeau et al., 2020). Most children with autism will eventually develop spoken language, but will likely experience continuing social-communication impairments. Some of the social-communicative impairments associated with autism include difficulties in (a) maintaining eye contact, (b) establishing joint attention, and (c) appropriate use of gestures (Brigido et al., 2021; Goldberg et al., 2005). Approximately 25–35% of children with autism fail to develop any appreciable amount of speech and are thus considered to be minimally verbal (Kasari et al., 2013). Rose et al. (2016) studied a cohort of 246 children with autism receiving early intervention and found that 26.3% had "fewer than five spontaneous and functional words" and another 36.4% had not achieved two-word utterances (p. 464).

Children with autism who develop spoken language skills often appear to use these skills in a seemingly nonfunctional and stereotyped manner. For example, the child might simply repeat another's speech (echolalia) or perseverate on certain words and phrases. Generally, children with autism present with better instrumental communication skills (e.g., requesting and rejecting) than social communication skills (e.g., commenting and topical conversation). Children with autism are also often unresponsive to other's speech. For example, the child might fail to respond when their name is called (Miller et al., 2017). Such lack of response could indicate attentional problems, lack of social motivation, or limited receptive language. Overall, as Douglas and Gerde (2019) noted, children with autism have considerable difficulty with respect to the acquisition and functional use of a range of receptive and expressive communication skills, such as expressing wants and needs, asking and answering questions, following spoken directives, making comments, and initiating conversations.

Communication Assessment

A range of ABA-based procedures have been developed to assess the nature and severity of communication impairment in children with autism. Assessment is used to identify communication deficits and corresponding areas in need of improvement (e.g., limited speech, lack of communicative initiation). Assessment is also used to identify problematic patterns of communication such as echolalia and perseverative speech. ABA-oriented assessments also often focus on identifying the child's existing communication strengths such as the existing communication forms used by the child and the meaning or function of these forms.

Communication assessment can be seen as an important step in the overall intervention process. The information provided by a communication assessment can often be used in the selection of treatment objectives and to inform the design of intervention procedures (Esch et al., 2010; Padilla, 2020). In this section, we focus on assessments that are consistent with an ABA framework and which are primarily aimed at generating data on the child's communicative functioning for the purpose of intervention planning.

When assessing the child's communication repertoire, it is important to consider their current abilities and skills, the environmental demands of the settings in which they are expected to communicate, and the people they communicate with in those settings. Communication assessments often focus on documenting the communicative forms (e.g., vocalizations, gestures, words) used by the child. This type of information is important because it can provide data on the range of potential communicative acts that the child may be able to express. Within an ABA paradigm, it is also important to ascertain the function or the purpose of any communication forms used by the child (Carnett et al., 2019). What, for example, is the child attempting to communicate via their existing vocalizations, gestures, or speech? Are they making a request (or mand) or are they making a comment (i.e., a tacting response)?

Along these lines, Skinner's (1957) analysis of verbal behavior provides a conceptual framework for assessing communicative forms and functions as well as assessing the influence of a range of environmental variables on the child's communicative functioning (Esch et al., 2010; Ingvarsson, 2016; Michael, 1984). It is important to note that the term "verbal behavior" refers to any form of behavior that can provide an effective signal to a listener. It does not just refer to spoken language. The implication is that, especially for individuals its minimal vocal speech, it will be important to assess for the presence of, and propensity to acquire, non-speech or augmentative and alternative communication (AAC) modes of communication. Alternative and AAC modes might involve vocalizations, natural or idiosyncratic gestures, facial expressions, body movements, manual signs, and visual-graphic modes, such as exchanging pictures or tapping icons on a speech-generating device.

Various assessment procedures, both direct and indirect, have been developed to assess the communicative forms and functions of children with autism and the influence of environmental variables on the child's communicative functioning (Ferreri & Plavnick, 2011; Lerman et al., 2005; Normand et al., 2008). Indirect assessments typically involve the use of interviews, rating scales, or questionnaires. Direct assessments, in contrast, typically involve observing the child's responses to structured communicative opportunities or temptations. These two categories of assessments can often be used together to identify communication deficits and excesses, the forms and functions present or absent in the child's repertoire, and the environmental conditions under which various communication skills (e.g., requesting help and responding to questions) either occur or fail to occur.

One indirect assessment is the Verbal Behavior Assessment Scale (VerBAS; Duker, 1999). This tool consists of 15 questions that seek information on the child's abilities across several basic communicative functions (e.g., manding or requesting, tacting or naming, and echoic or imitative communication). The VerBAS can be completed by caregivers, teachers, or family members who are familiar with the individual's communication skills. Results from a VerBAS assessment can be used to identify areas where the child is showing deficits (e.g., limited tacting skills), which can, in turn, inform the selection of priority intervention targets (e.g., teaching the child to tact or name objects and actions).

Another indirect assessment is the Behavioral Language Assessment Form (BLAF; Sundberg & Partington, 1998). This tool includes 60 questions that sample the child's skills across 12 communication-related domains. The results provide a comprehensive profile of the child's specific communication skills and additional skills that can inform the selection of intervention procedures (Sundberg & Partington, 1998). Specific communication skills that are assessed include requesting, vocal imitation, labeling, and conversational skills. Specific additional skills assessed include cooperation, motor imitation, and matching-to-sample skills. Information about these latter additional skills can be helpful for designing and sequencing intervention. A child who is rated as being uncooperative, for example, might require an intervention program that includes reinforcement for attending and for cooperating, in addition to explicit instruction aimed at teaching specific communication skills, such as requesting preferred items and naming (tacting) common objects found in the home, school, and community.

These types of indirect assessments can often provide useful information—when that information is provided by a reliable informant—on an individual's current strengths and deficits. Information of this type is a useful first step in ascertaining the child's communication abilities and consideration of intervention priorities (Carnett et al., 2019; Lerman et al., 2005). However, it is often helpful to attempt to verify the validity of this information through the completion of a more direct assessment.

Several direct assessments have been developed to assess communicative behavior. Table 9.1 provides a summary of several direct assessments for assessing communication functioning of children with autism. For example, the Social Communication Assessment for Toddlers with Autism (SCATA; Drew et al., 2007) is a direct measure specific to young children. It was designed to be sensitive to non-vocal communi-

Table 9.1 Examples of direct ABA-based communication assessments

Assessment instrument	Description
Assessment of Basic Language and Learning Skills—Revised (ABLLS-R)	Developmentally-based verbal behavior assessment that is appropriate for young children.
Essential for Living	Appropriate for older persons with developmental disabilities or those with more complex needs.
Social Communication Assessment for Toddlers with Autism	Designed to measure non-vocal communication in young children with autism.
Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP)	Developmentally-based verbal behavior assessment that is appropriate for young children.

cative behavior (e.g., gestures). The protocol is typically implemented by trained personnel during free play and more structured turn-taking activities. Data are collected on frequency, form, function, complexity of the child's communication responses, and the child's role in social-communicative interactions (i.e., speaker or listener). Drew et al. (2007) conducted a preliminary study evaluating the use of the SCATA to assess communication in two groups of toddlers with autism. Findings indicated the frequency and function of the child's communication skills were positively associated with later language development. Specifically, social acts, comments, and initiations showed a greater predictive association than requests and responses. These data suggest that a SCATA assessment can provide valuable predictive information, which could be helpful for intervention planning. A young child who is assessed as having a relatively low frequency of conversational initiations, for example, could be seen as being at-risk for language delay and might thus be a candidate for an early intervention program aimed at increasing the frequency with which the child initiates conversations with parents, preschool staff, peers, and siblings.

Another assessment for evaluating early communication ability is the Assessment of Basic Language and Learning Skills-Revised (ABLLS-R; Partington, 2010). This is a developmentally-based and criterion-referenced protocol that assesses 544 skills across 25 domains, including language, self-help, academic and motor domains. The main purpose of the ABLLS-R is to identity functioning deficits. The ABLLS-R can also be used as an outcome measure to evaluate intervention outcomes. Results of an ABLLS-R assessment could also be used for developing curriculum content, such as selecting specific communication skills for intervention. The ABLLS-R has received a considerable amount of research attention. Partington et al. (2018b), for example, examined the internal consistency and test-retest reliability of this instrument using data from typically-developing children. Findings suggested the instrument has good internal consistency and reliability. Further research has demonstrated good content validity and inter-rater reliability (Usry et al., 2018). Specifically, experts rated 81% of items included in the assessment as essential. Further, inter-rater reliability was evaluated by calculating the intraclass correlation coefficient (=.95, $p < .001$), which represents a high degree of reliability.

Partington et al. (2018a) also evaluated the pattern of skill development using the ABLLS-R. In this study, 53 typically-developing children were assessed using the ABLLS-R to examine skill development across the major skill categories (e.g., visual performance, vocal imitation, requests). The results suggested that by 6 years of age, there was generally better mastery of motor skills and self-help skills than academic skills, as would be expected for children at this age/stage of development.

Another commonly used assessment is the Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP; Sundberg, 2014). The VB-MAPP is based on Skinner's (1957) analysis of verbal behavior. It assesses the strength of the child's repertoire with respect to the basic verbal operants defined by Skinner (e.g., mands, tacts, echoics, and intraverbals). The emphasis is on early language development from birth to 4 years of age. Children's vocal responses, social play, functional communication behavior, and beginning academic skills are assessed. Content validity for the VB-MAPP was examined by Padilla and Akers (2021). In this study, 13 experts evaluated the domain relevance, age appropriateness, measurement appropriateness, and domain representation. Results indicated moderate to strong evidence for the domain relevance, age appropriateness, method of measurement, and domain representation.

Another assessment and curriculum guide that utilizes Skinner's (1957) analysis of verbal behavior is the Essential for Living (EFL) assessment. This assessment has both an indirect (an initial interview with parents, caregivers, instructors) and direct (observation and testing) component. The direct component can provide confirmation of the information provided by informants completing the indirect assessment. In contrast to the ABLLS-R and VB-MAPP, the

EFL can be used with all ages, rather than just children. This assessment targets both listener and speaker behavior and focuses on determining which skills are necessary for promoting independence in the daily life domain as well as for improving overall quality of life (McGreevy et al., 2012). The EFL is broken down into seven domains and covers a variety of skill categories (e.g., requesting, listener responses, daily living). One of the unique features of EFL is that a decision-making structure for setting learning priorities is embedded into the assessment process (i.e., the eight essential skills).

In summary, assessment of the child's communication deficits, excesses, and strengths is used to assist in mapping the child's communication repertoire and for identifying intervention priorities. When assessment data reveal that a child lacks acceptable ways to indicate likes and dislikes, for example, then logical intervention targets include teaching appropriate requesting and rejecting skills (Choi et al., 2010). In contrast, if the child's speech is largely echolalic, then an intervention aimed at replacing echolalia with functional speech (e.g., vocal labeling responses) is indicated (Foxx et al., 2004). ABA-based interventions have been successfully applied to achieve these and other intervention goals derived from the prior assessment of communication ability.

Communication Intervention

Lovaas et al. (1966) reported the first systematic use of an ABA-based intervention for teaching communication skills to children with autism. Their intervention focused on teaching two initially mute children to imitate speech. This objective was accomplished using shaping and differential reinforcement procedures. Later, Lovaas and colleagues showed how ABA principles and procedures could be applied to teach a wider range of more advanced language skills, including receptive labeling, expressive labeling, requesting objects, and answering questions (Lovaas, 1977; Lovaas et al., 1973). Since these early pioneering efforts, numerous studies have demonstrated the efficacy of behavior-analytic principles and procedures (e.g., reinforcement, shaping, prompting, prompt fading, and discrimination training) for teaching a range of communication and other adaptive skills to children with autism (Lang & Sturmey, 2021; Makrygianni et al., 2018; Sigafoos, 2021).

In addition to targeting spoken language, minimally verbal children have been successfully taught to use a range of AAC-based communication skills. For example, children with autism have been successfully taught to use manual signs and various symbol-based or picture-based communication systems, such as the picture-exchange system and electronic speech-generating devices (Aydin & Diken, 2020; Bondy, 2012; Carr, 1982; Evans & Spittle, 1981; Ganz, 2014; Schlosser & Koul, 2015). In fact, contemporary practice has increasingly explored the feasibility and potential benefits of teaching children to communicate using multiple modalities. Brady et al. (2015), for example, evaluated outcomes for 10 children with autism who received a multimodal intervention package that included practicing speech sounds and using AAC. They reported gains in word learning for 5 of the 10 participants. Brady et al. noted that these five children tended to have higher levels of receptive language, prelinguistic behavior, vocal imitation, and consonant production. This suggests the need to consider the child's level of communicative functioning when designing a multimodal intervention package. The results also suggest the potential value of extending intervention efforts to what might be seen as foundational abilities, specifically receptive language, prelinguistic behavior, and imitative speech.

There is ample evidence that AAC can provide viable modes of communication for minimally verbal children with autism (Aydin & Diken, 2020; Ganz, 2014). AAC interventions may also have a modest facilitative effect on natural speech production for some children with autism (Schlosser & Wendt, 2008; Syriopoulou-Delli & Eleni, 2021). This generally promising evidence suggests that early introduction of AAC should be considered when there is a significant delay or lack of speech development and certainly if the child fails to acquire speech by age 3 (National Research Council, 2001). Reichle et al. (2021) have provided a conceptual overview of how various ABA principles and concepts (e.g., pivotal behavior, matching law, response efficiency, and general case instruction) can be fruitfully employed when designing AAC interventions.

With respect to the relative merits of different AAC modalities (e.g., manual signing versus picture exchange versus speech-generating devices), the results of a review of 11 relevant studies by Aydin and Diken (2020) suggested that interventions aimed at teaching picture exchange or speech-generating devices were generally more effective than interventions aimed at teaching manual signs. This finding might not necessarily point to any inherent limitation of manual signing as a mode of communication. Rather, the finding might simply indicate that teaching manual signs requires greater clinical expertise than does teaching picture exchange or speech-generating device use.

Instructional Tactics

Instructional tactics for teaching communication skills to children with autism typically include some combination of the following procedures: (a) time delay, (b) least-to-most prompting, (c) most-to-least prompting, (d) graduated guidance, (e) modeling, including video modeling, (f) differential reinforcement, and (g) error correction (Aydin & Diken, 2020; Hume et al., 2021). Snell et al. (2006) classified instructional principles into two categories based on the timing of their application in the instructional sequence. Antecedent-based strategies include various response prompting techniques and environmental manipulations that are typically implemented at the beginning of a teaching sequence. Such strategies are often used to create an effective opportunity for teaching communication skills and to ensure the child produces the target communication response during each opportunity. Examples of antecedent-based strategies include:

1. Response prompting—use of verbal, gesture, model, or physical assistance to evoke a correct response from the child. This can include various ways of delivering or sequencing prompts, such as using a least-to-most sequence, a most-to-least sequence, or applying a graduated guidance technique in which the instructor delivers the least amount of physical assistance that is necessary to ensure that the response occurs.
2. Time delay—waiting for a certain period of time after presenting a discriminative stimulus (and before prompting the correct response). The intent is to build motivation for independent responding. Time delay can be constant (always wait 10 s before prompting) or progressive (wait increasing amounts of time before prompting, e.g., 3 s, 5 s, 10 s).
3. Proximity—place discriminative stimuli in conspicuous locations.
4. Multiple stimuli—include several examples of discriminative stimuli during training. For example when teaching the child to label or tact common objects (e.g., books, chairs, and utensils.), it would be important to use a variety of exemplars to represent each object class. These exemplars should vary systematically to sample the range of variation found within the class or to represent "the general case".
5. Capture motivation—follow the child's lead, wait for the child to initiate a request by reaching for or leading you to an object, make use of preferred stimuli and activities.
6. Naturalistic and embedded instruction—incorporate opportunities for communication within the natural flow of a range of typical routines, such as mealtimes, play, and recess.

Consequent-based strategies, in contrast, are typically implemented in response to the child's communicative behavior or attempts. Examples of consequent-based strategies include:

1. Specific reinforcement—provide reinforcement that is relevant to the child's response (e.g., if child requests "Drink," then respond to that request by giving the child his or her

preferred beverage as a reinforcer. If the child comments on the environment ["It's raining."], then respond accordingly ["Yes, I see, it is raining out there. Thanks for letting me know."]).

2. Contingent and immediate reinforcement—specific reinforcement should be delivered immediately, but only after the child makes the correct communicative response.
3. Error correction—incorrect communicative attempts should be interrupted and corrected using an effective response prompt.

In practice, antecedent-based and consequent-based strategies can and should be combined and used in flexible ways that are responsive to the child's ongoing behavior. If a child begins to make the wrong manual sign in response to a communication opportunity, for example, this error should be interrupted, and the correct sign prompted and then reinforced. A general guideline is that each and every communicative opportunity should be arranged so as to increase the probability of correct unprompted responses and to ensure that the child receives an appropriate type and amount of reinforcement for their communicative behavior. Intervention can be considered complete only when the child has acquired a large repertoire of communication skills that are evoked and maintained by the same contingencies of reinforcement that operate in the natural environments of the home, school, and community.

The generic ABA-based instructional tactics outlined above can all be considered well-established and research-based (Hume et al., 2021). These types of ABA procedures appear sufficiently robust in the sense that they often remain highly effective when applied or packaged in various ways. The robust nature of these procedures enables individualization and flexibility in the provision of ABA-based communication intervention to children with autism. The fact that ABA-based treatments can be effectively applied in a variety of flexible ways has enabled researchers to package these various applications into more comprehensive intervention programs, such as the Picture Exchange Communication System (PECS; Bondy, 2012), Pivotal Response Training, and Applied Verbal Behavior (LeBlanc et al., 2006; Matson et al., 2008; Sigafoos, 2021).

There are many examples where generic ABA techniques have been packaged into programs for teaching communication to children with autism (Sigafoos, 2021). However, any ABA-based instructional tactic or combination of tactics (e.g., time delay, least-to-most prompting, and reinforcement) is likely to be effective only to the extent that the underlying operant and respondent learning principles have been adequately considered and incorporated into the intervention. Treatments often fail because practitioners lack the knowledge and expertise that would enable them to modify instructional procedures to suit the context and the unique needs of the individual child (Linscheid, 1999).

Defining Features of ABA-Based Communication Interventions

In addition to the systematic application of well-established instructional tactics, ABA-based interventions are characterized by a number of distinct features as first delineated by Baer et al. (1968, 1987). These features include a focus on clinically significant behavior change, direct measurement of target behaviors, and interventions that are derived from foundational principles of learning, especially operant conditioning. Table 9.2 presents the main distinguishing features of ABA and how these features could be incorporated into the design of communication interventions for children with autism.

Functional Communication

ABA-based approaches emphasize the application of systematic instructional tactics to teach functional communication skills based on Skinner's (1957) analysis of verbal behavior. Table 9.3 lists the basic communication functions, or verbal operants, defined by Skinner and

Table 9.2 Dimensions of ABA applied to the communication domain

Dimension	Description	Application to communication
Applied	Focus on socially important behaviors.	Practitioners should focus on teaching communicative behaviors that will enhance functioning and quality of life.
Behavioral	Direct observation and measurement of behavior.	Practitioners must objectively define communication behaviors in ways that make them observable and measurable.
Analytic	Convincing demonstration that intervention was responsible for behavior change	Practitioners should include repeated measures of communication behavior prior to, during, and after intervention to determine whether the intervention did in fact produce behavior change.
Conceptual	ABA is based on, derived from, and consistent with empirically validated principles of learning (e.g., shaping, chaining, stimulus control and reinforcement)	Practitioners should be able to identify the fundamental learning principles or mechanisms that underlie effective communication intervention.
Technological	ABA interventions are objectively described in sufficient detail to enable independent replication.	Practitioners must be able to provide a step-by-step description of their intervention procedures to facilitate correct implementation by parents, teachers, etc.
Generalized outcomes	ABA interventions will be more efficacious when behavior change is maintained and appropriately generalized to new settings, materials, and people.	Practitioners should incorporate strategies to promote maintenance and generalization into their communication interventions.
Effective	ABA interventions are considered to be effective only if they yield clinically significant improvement in behavior.	Communication intervention is effective to the extent that it produces large and meaningful changes in the child's communication repertoire.

Based on Baer et al. (1987)

Table 9.3 Examples of functional communication skills

Operant Class	Examples
Mand (request)	Request object (e.g., food, drinks, toys) Request a missing, but needed item (a spoon needed to eat) Request more of an object Request more of an activity Request activity (television, music, swinging) Request attention from adult Request help and assistance with a difficult task Request information (e.g., Where is it?) Request a break from a task
Mand (reject/protest)	Reject the offer of a non-preferred object Reject the offer to participate in a non-preferred activity Reject the offer of a wrong item Request the removal of non-preferred items Request the cessation of an activity or stimulus
Tact (name/comment)	Naming objects and actions Naming a property of an object (big, small, red, blue) Labeling the location of objects (on top, under, next to) Describing a previously observed object or event
Echoic (imitation)	Imitate speech Imitate manual signs Reply to greetings (Hi → Hello) Conversational overlap ("What movie did you see on the weekend?" → "The movie I saw on the weekend was . . .")
Intraverbal (answer/classify, conversation)	Name items in categories (e.g., "What are some colors?"). Answer questions (e.g., "What is your name?") Maintain conversation ("Nice day today." → "Yes, I might go out for a walk."

associated specific communication skills. The mand, for example, includes a number of more specific requesting and rejecting skills, such as (a) requesting preferred objects, (b) requesting missing but needed items, (c) requesting access to preferred activities, (d) requesting help or assistance, (d) requesting information, and (e) rejecting the offer of a non-preferred object. Tacting, similarly, covers many more specific skills such as naming objects or actions and commenting on aspects of the environment (e.g., "That's a ball," "That's a car," "He is running," "It's raining," and "The telephone is ringing,").

The communication functions outlined in Table 9.3 have been successfully taught to children with autism using ABA-based instructional tactics. Choi et al. (2010), for example, used progressive time delay, gesture prompts, and error correction to teach mands related to requesting and rejecting. The four children specifically learned to select graphic symbols to request items needed for accessing a reinforcer, such as requesting the key needed to open a box or requesting the straw needed to drink from a juice box. The children were also taught to reject wrong items by selecting the *NO* symbol if they were offered a DVD after requesting a straw, for example. Similarly, Carnett et al. (2020) used least-to-most prompting to teach three children with autism to use a speech-generating device to ask for the location of needed but missing items (*Where is x?*). With respect to tact acquisition, Conallen and Reed (2016) successfully taught 10 children with autism to tact emotional states. The emotional states were described and illustrated in cartoon scenarios (picture of a boy receiving a puppy) as the instructor explained the scene and asked, *How does he feel?* Children were taught to match the correct emotion card (Happy, Sad, or Angry) to each scenario. To teach intraverbal responding, Goldsmith et al. (2007) asked questions of three children with autism (e.g., *What are some fruits?* and *What are some things you wear?*). A 3-s constant time delay was then used. Correct spoken responses that occurred within the 3-s delay interval were reinforced with praise and preferred edibles. Picture and verbal prompts (*Say apple)* were used when correct responses did not occur within 3 s.

Another important verbal operant is the echoic or imitative response. Echoic training typically involves shaping, modeling, and reinforcement. For example, the child might first be taught to imitate a single speech sound or a simple manual sign by modeling the target behavior, waiting for the child to attempt the response, prompting the response as necessary, and then providing reinforcement. In addition, as the child acquires the basic responses, the instructor would gradually increase the complexity of the model (Carnett et al., 2019; Lovaas et al., 1966).

Overall, a variety of functional communication skills have been successfully taught to children with autism using ABA-based instructional tactics (Sigafoos, 2021). Improved communicative functioning has been achieved by teaching children to use communication modes suitable for their abilities and context. When speech development is limited, viable alternative communication modes for children with autism include prelinguistic behavior, manual signing, picture exchange, and speech-generating devices (Mirenda & Iacono, 2009).

Structured and Naturalistic Intervention

ABA-based communication interventions often make use of highly structured discrete-trial training (DTT) formats (Hume et al., 2021; Sigafoos et al., 2019). For example, intervention might occur in 20-min sessions during which the trainer could present numerous discrete-training trials. With this DTT approach, each discrete trial typically consists of three components: (a) presentation of a discriminative stimulus (e.g., holding up an object and asking, "What is this?"), (b) waiting for a correct response and, if not forthcoming, delivering effective response prompts as necessary to ensure that the child makes the correct response, and then (c) delivery of reinforcement contingent upon correct responding. Over successive trials, prompts are faded to reduce prompt dependency and promote spontaneity. In a review of the literature on the use of structured, discrete-trial training approaches, Lerman et al. (2016) concluded that more than 40 years of research has consistently provided evidence that supports the efficacy of this paradigm for "remediating the myriad of social, communication, academic, and self-help difficulties that are associated with a diagnosis of autism spectrum disorder (ASD)." (p. 47).

In addition to the use of structured, discrete-trial training arrangements, there has been increasing interest in the application of more naturalistic or incidental teaching arrangements (Blackwell & Stockall, 2021). Schreibman et al. (2015) described a specific genre of naturalistic teaching arrangements that are known as naturalistic developmental behavioral interventions or NDBIs. NDBIs are characterized by four main features. First, teaching generally occurs in natural settings during appropriate routines, such as play time. Second, there is a mix of teacher-initiated learning opportunities and opportunities that capitalize on child initiations (i.e., following the child's lead). Third, there is reliance on natural reinforcement. Fourth, NDBIs make use of "a variety of behavioral strategies to teach developmentally appropriate and prerequisite skills" (Schreibman et al., 2015, p. 2411).

For example, teaching opportunities could be embedded within the flow of a natural routine, such as during meals, toy play, or during a designated story time at home or school. In addition, teaching should also occur in the natural environment when opportunities for communication arise in response to a child's initiations. For example, prior to bedtime, a parent might undertake communication intervention within the context of a book reading activity in response to the child reaching toward a stack of storybooks. The child's reaching behavior suggests that motivation is present, which is the optimal time to implement a teaching opportunity. The child might first receive an opportunity to make a request for a specific book. After that, additional opportunities might be embedded within the activity to teach various picture-naming (i.e., tact) responses ("What animal is that?," "What color is that?"). The teacher or parent would also use natural consequences, such as providing the child with items he or she has requested or acknowledging the child's comments (e.g., "Yes that is the color red." "You are very smart!"). Teaching materials and routines should be age-appropriate, such as by using preschool toys with young children and perhaps video games with adolescents. As Schreibman et al. (2015) also noted, the skills targeted for intervention should also be developmentally appropriate, such as teaching young children to name animals and colors in preschool books and teaching adolescents to initiate task-related conversations with peers during small-group learning activities in the classroom. Prerequisite skills (e.g., attending, joint attention, and imitation) are also often targeted in NDBIs, especially with younger children.

A study by Tupou et al. (2020) illustrates the application of this type of more naturalistic approach for increasing the communication responses of children with autism. The study involved three minimally verbal children (aged 3–4 years) with autism. The children's respective preschool teachers implemented a play-based intervention following the manualized Early Start Denver Model (Rogers et al., 2012). The instructional tactics associated with this model include several ABA-based procedures, such as presenting clear cues or discriminative stimuli to evoke a response, using natural reinforcement to strengthen children's communication responses, and modeling a range of communication responses. The intervention also included several additional tactics that could be seen as derived from developmentally-based approaches. These additional tactics included (a) narrating the child actions to enhance social interaction and develop the child's receptive language skills, and (b) expanding on the child's communicative attempts to advance the child's language development. The techniques associated with this type of NDBI (Schreibman et al., 2015) are meant to be implemented in a flexible manner within naturalistic routines, such as during interactive play sessions involving the children's chosen and preferred toys and games. The interventionist is also meant to remain highly responsive to the child's ongoing interests and actions. For example, the interventionist would wait for the child to show interest in a particular object, activity, or topic and then capitalize on this interest by implementing an instructional opportunity. Tupou et al. collected data on the children's participation, intentional vocalizations, and imitation over a 10-week intervention period. The results showed modest increases in the dependent variables and these gains were generally maintained at an 11-week post-intervention follow-up.

There is a growing number of studies reporting positive outcomes for children with autism who participate in these types of more naturalistic interventions (Kasari et al., 2006; Schreibman et al., 2015; Tiede & Walton, 2019; Tupou et al., 2019). As with many types of communication programs, the duration and intensity of intervention are likely to influence the magnitude of the treatment effect (Parker-McGowan et al., 2014).

A potential problem with naturalistic intervention approaches is that some children may show little initiation of communication behavior during naturalistic play routines. As a result, there may be relatively few opportunities for instructors to follow the child's lead and thus reinforce and expand on the child's communicative attempts. In such situations, there could be value in incorporating some discrete-trial training opportunities into the instructional mix. For example, multiple structured opportunities to teach requesting and commenting could be initiated by the teacher and embedded into the natural flow of an interactive play routine. A combination of discrete-trial training with naturalistic teaching arrangements could represent one way to increase the number of opportunities for teaching functional communication skills across a range of settings and daily activities. This approach might, in turn, facilitate not only acquisition but also generalization and maintenance.

Prelinguistic Behavior

Recognition of children's prelinguistic behavior is a notable trend in autism research and practice (Keen et al., 2016). Examples of prelinguistic behaviors include crying, vocalizations, reaching, body movements, eye gaze, and facial expression. Establishing joint attention with communicative partners is another aspect of prelinguistic development that is often difficult for children with autism (Jones & Carr, 2004). Research has shown that prior to the emergence of speech, these types of prelinguistic acts gradually acquire communicative intent (Crais & Ogletree, 2016). The transition begins from birth as parents respond to children's prelinguistic actions as if the child was attempting to communicate intentionally. Being highly responsive to children's early prelinguistic behaviors appears to facilitate their later speech and language development (Crais & Ogletree, 2016). Perhaps not surprisingly, many children with autism are reported to have considerable difficultly with the transition from prelinguistic to symbolic communication when compared to typically developing children (Iverson & Wozniak, 2016). This could be due in part to their relatively lower rates of communication initiation than evidenced by their typically developing peers (Stone & Yoder, 2001).

Prelinguistic intervention efforts have followed two main avenues that are somewhat distinct but not necessarily mutually exclusive. The first aims to replace the child's existing prelinguistic behavior with more conventional forms of communication. For example, autistic children often show a tendency to lead an adult by the hand as a means of requesting help or gaining access to reinforcement. While prelinguistic leading can be effective for the child, it can also be seen as potentially limiting and socially stigmatizing, especially when used by older children or with less familiar listeners. To advance the child's communication development, ABA interventions have been developed to replace the child's prelinguistic leading behavior with more symbolic communication forms, such as teaching the child to use a formal pointing gesture to makes requests of an adult (Carr & Kemp, 1989). This type of replacement approach is indicated when the child's prelinguistic forms are seen as limiting, age-inappropriate, or too subtle and hence difficult for unfamiliar listeners to interpret.

The replacement approach is also indicated when the child's prelinguistic forms of communication are socially unacceptable, such as when the child engages in tantrums, aggression, self-injury, or other forms of challenging behavior to communicate (Sigafoos et al., 2016; Williams et al., 2018). In such cases, a widely used treatment approach, known as functional communication training (FCT), is indicated (Carr & Durand, 1985; Durand & Moskowitz, 2015; Reichle & Wacker, 2017). FCT aims to replace problematic behavior with more conventional and socially acceptable forms of communication. For example, if a child's tantrums function as requests for preferred items, then an FCT intervention would focus on teaching the child to make requests using speech, manual signs, or perhaps a picture-exchange communication system. A large research literature covering more than 35 years supports the use of FCT as a treatment for problem behavior in persons with autism and other developmental disabilities (Durand & Moskowitz, 2015; Gerow et al., 2018; Walker et al., 2018). While a review of this literature is beyond the scope of this chapter, the research evidence points to three critical components for successful application of FCT. First, it is important that the problematic and replacement behaviors are functionally equivalent (Carr & Durand, 1985; Durand & Moskowitz, 2015, Reichle & Wacker, 2017). This means that the targeted replacement behavior must serve the same [communicative] function or purpose as the existing problem behavior. Evidence for functional equivalence is gathered by first undertaking a functional assessment aimed at identifying the antecedent variables that evoke the behavior and the consequences that maintain that behavior (Reichle & Wacker, 2017). Thus, a prior functional assessment is a critical initial step in using FCT. Second, it is critical that the replacement behavior is taught in a way that makes it more efficient than the existing problem behavior (Horner & Day, 1991). Efficiency in this context means that the replacement behavior requires less effort and is reinforced more quickly and consistently than the existing problem behavior. Reichle and Wacker (2017) provide a detailed account of the instructional processes involved in the application of FCT. Third, in situations where reinforcement is not available, even when requested appropriately, the use of a discriminative stimulus (e.g., differently colored cards) can make it clear to the child when a reinforcer is or is not available without resulting in a relapse to problem behavior (Mitteer et al., 2020). That is, the child is taught to request when reinforcement is available and to refrain from requesting when reinforcement is not available.

The second objective associated with prelinguistic intervention is to strengthen the child's existing prelinguistic skills and facilitate the transition to symbolic communication. This objective would seem particularly relevant in early intervention programs and for minimally-verbal children functioning at the prelinguistic stage of communication development. Along these lines, Dubin and Lieberman-Betz (2020) reviewed 25 studies that evaluated the use of NDBIs for improving the prelinguistic communication skills of children with autism. These studies were mainly aimed at strengthening children's use of several discrete behaviors (e.g., gestures, vocalizations, and gaze shift) for the purposes of requesting and initiating joint attention (e.g., using gaze shift to direct the listener's attention). There were, however, some studies included in this review that focused on the use of prelinguistic forms for other communicative functions, such as commenting. The intervention procedures applied across these studies generally used a variety of instructional tactics, including (a) response prompting, (b) natural reinforcement, (c) use of natural routines as the context for instruction, and (d) arranging the environment to create communication temptations/opportunities. Other procedures used in some studies included time delay, narrating the child's behavior, discrete-trial training, and imitating the child's behavior. The interventions occurred within one-to-one, small group, and classroom configurations and were successfully delivered by a range of individuals, including teachers, parents, therapists, and research personnel. Despite the variety of implementation arrangements and instructional tactics used across these 25 studies, the results overall were generally positive. More generally, a review by Schreibman et al. (2015) provided additional support for the use of NDBIs with children with autism.

Collectively, the evidence suggests that NDBIs are fairly robust and can be effective even when different instructional tactics and delivery configurations are implemented. The important factors for success might depend less on the specific intervention program, manual, or package applied and more on ensuring these are derived from empirically-validated principles of learning, behavior, and development (Linscheid, 1999). Use of ABA-based instructional tactics and being responsive to the child's ongoing motivational states and communicative attempts could also be seen as vital features of good ABA-based communication intervention.

Visual Strategies

Visual strategies or visual supports are frequently used in the education of children with autism. Visual strategies include certain AAC modes (e.g., manual signing, picture-exchange) and use of visual materials (e.g., drawings, photographs, miniature objects, printed conversational scripts, scene cues, and video) to support receptive language and other adaptive behavior, such as following a daily schedule, transitioning from one activity to another, completing homework, getting dressed, and initiating a conversation (Bondy & Frost, 2003; Rutherford et al., 2020).

Shane and colleagues developed and evaluated an assessment and intervention package heavily reliant on technology-based visual strategies. The package is aimed at addressing several common areas of communication difficulty experienced by individuals with autism (Schlosser et al., 2020, 2021; Shane et al., 2015). More specifically, their Visual Immersion System™ (VIS™) includes assessment and intervention components that aim to improve receptive and expressive communication, language proficiency, and executive functioning. The approach targets the following communicative operations/functions: (a) requesting, (b) protesting, (c) commenting, (d) answering questions, (e) asking questions, (f) following directives, (g) social pragmatics functions, and (h) organization (e.g., transitions). The approach is based on evidence suggesting that individuals with autism appear to have relative strength in learning via the visual modality and also seem to enjoy using electronic screen media. The aim of VIS™ is to enhance the person's ability to communicate by using visual supports to supplement or replace natural speech (Schlosser et al., 2021). For example, individuals might be provided with animated graphic symbols, video clips, and specific technology (e.g., Smartspeakers and Smartwatches) to enable various communication functions. Teaching procedures include video modeling, use of picture cues, and feedback.

The VIS™ relies on several evidence-based components. For example, minimally verbal children seem to be better at identifying graphic symbols for verbs when the symbols are animated rather than static (Schlosser et al., 2019). Likewise, several studies have shown that augmented input that includes spoken input plus photographic scene cues helps children with autism to follow directives more effectively compared to spoken input alone (Allen et al., 2021; Choe et al., 2020; Schlosser et al., 2013).

An emerging evidence base suggests that the VIS™ could be a promising approach for enhancing the communication abilities of children with autism. The approach—given its emphasis on visual rather than purely auditory spoken communication—would seem to be particularly relevant for minimally verbal children with autism. Along those lines, Schlosser et al. (2020) described the application of the VIS™ approach in a classroom that included seven children (aged 6–8 years) with autism. Four of the children reportedly used some speech, whereas the other four used AAC. The children's communication abilities were first assessed to establish a baseline and select treatment goals. Treatment goals included increasing requesting, commenting, and answering. For intervention, school staff attended a workshop on the VIS™ and then participated in bi-weekly videoconferencing focused on prioritizing goals, applying the technology and visual supports, managing child problem behavior, and classroom design. The results suggested the program was viable and promising for improving the children's communication. Given these promising results, additional evaluations using more rigorous designs are indicated.

Overall, while visual supports are generally considered useful, Rutherford et al. (2020) noted that the literature is relatively sparse in terms of the number of high-quality studies. Visual communication modalities are certainly widely used and can provide children with autism with a viable and effective means of functional communication. It is also clear that functional use of visual communication modes can be successfully taught using ABA-based instructional tactics. What remains to be determined through future research is the general effectiveness of more comprehensive visual support strategies, such as the VIS™, for enhancing the communication and related adaptive functioning of children with autism.

Summary

Autism is associated with a wide range of communication deficits and excesses that can negatively affect the child's quality of life. Communication assessment and intervention represent major educational priorities for many children with autism. ABA-based approaches have a history of demonstrated success in addressing the communication needs of children with autism. Research within the discipline of ABA has led to several reliable and valid assessment protocols to ascertain the child's level of communicative functioning, identify intervention priorities, and inform intervention efforts. ABA research has also generated a range of research-based instructional tactics with demonstrated success in teaching children to use a range of communication modalities, (e.g., speech, manual signing, picture-exchange, and speech-generating devices) to accomplish a range of communicative functions (e.g., requesting, rejecting, commenting, answering, and questioning). Contemporary applications of ABA-based instructional tactics include (a) adopting a more naturalistic teaching approach, (b) focusing on prelinguistic behavior, and (c) using visual strategies to enhance the communicative functioning of children with autism.

References

Allen, A. A., Shane, H. C., Schlosser, R. W., & Haynes, C. (2021). The effect of cue type on directive-following in children with moderate to severe autism spectrum disorder. *Augmentative and Alternative Communication*. https://doi.org/10.1080/07434618.2021.1930154

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association. https://doi.org/10.1176/appi.books.9780890425596.dsm05

Aydin, O., & Diken, I. H. (2020). Studies comparing augmentative and alternative communication systems (AAC) applications for individuals with autism spectrum disorder: A systematic review and meta-analysis. *Education and Training in Autism and Developmental Disabilities, 55*(2), 119–141.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91–97.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1987). Some still current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 20*, 313–327.

Bal, V. H., Fok, M., Lord, C., Smith, I. M., Mirenda, P., Szatmari, P., et al. (2020). Predictors of longer-term development of expressive language in two independent longitudinal cohorts of language-delayed preschoolers with autism spectrum disorder. *Journal of Child Psychology and Psychiatry, 61*(7), 826–835. https://doi.org/10.1111/jcpp.13117

Barbeau, E. B., Klein, D., Soulières, I., Petrides, M., Bernhardt, B., & Mottron, L. (2020). Age of speech onset in autism relates to structural connectivity in the language network. *Cerebral Cortex Communications, 1*(1), 1–10. https://doi.org/10.1093/texcom/tgaa077

Blackwell, W., & Stockall, N. (2021). Incidental teaching of conversational skills for students with autism spectrum disorder. *Teaching Exceptional Children*. https://doi.org/10.1177/0040059921990405

Bondy, A. (2012). The unusual suspects: Myths and misconceptions associated with PECS. *The Psychological Record, 62*(4), 789–816. https://doi.org/10.1007/BF03395836

Bondy, A., & Frost, L. (2003). Communication strategies for visual learners. In O. I. Lovaas (Ed.), *Teaching individuals with developmental delay: Basic intervention techniques* (pp. 291–303). Pro-Ed.

Brady, N. C., Storkel, H. L., Bushnell, P., Barker, M., Saunders, K., & Daniels, D. (2015). Investigating a multimodal intervention for children with limited expressive vocabularies associated with autism. *American Journal of Speech-Language Pathology, 24*(3), 438–459. https://doi.org/10.1044/2015_AJSLP-14-0093

Brigido, E., Rodrigues, A., & Santos, S. (2021). Autism spectrum disorder behavioural profiles: A cluster analysis exploration. *International Journal of Disability, Development and Education*. https://doi.org/10.1080/1034912X.2021.1895084

Carnett, A., Raulston, T. J., & Charpentier, J. (2019). The application of Skinner's analysis of verbal behavior for teaching communication skills to persons with developmental disabilities. *Current Developmental Disorders Reports, 6*(3), 131–137. https://doi.org/10.1007/s40474-019-00170-0

Carnett, A., Ingvarsson, E. T., Bravo, A., & Sigafoos, J. (2020). Teaching children with autism spectrum disorder to ask "where" questions using a speech-generating device. *Journal of Applied Behavior Analysis, 53*(3), 1383–1403. https://doi.org/10.1002/jaba.663

Carr, E. G. (1982). Sign language. In R. Koegel, A. Rincover, & A. Egel (Eds.), *Educating and understanding autistic children* (pp. 142–157). College-Hill Press.

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*, 111–126.

Carr, E. G., & Kemp, D. C. (1989). Functional equivalence of autistic leading and communicative pointing: Analysis and treatment. *Journal of Autism and Developmental Disorders, 19*(4), 561–578. https://doi.org/10.1007/bf02212858

Choe, N., Shane, H. C., Schlosser, R. W., Haynes, C., & Allen, A. (2020). Directive-following based on graphic symbol sentences involving an animated verb symbol in children with autism. *Communication Disorders Quarterly*. https://doi.org/10.1177/1525740120976332

Choi, H., O'Reilly, M., Sigafoos, J., & Lancioni, G. (2010). Teaching requesting and rejecting sequences to four children with developmental disabilities using augmentative and alternative communication. *Research in Developmental Disabilities, 31*(2), 560–567. https://doi.org/10.1016/j.ridd.2009.12.006

Conallen, K., & Reed, P. (2016). A teaching procedure to help children with autistic spectrum disorder to label emotions. *Research in Autism Spectrum Disorders, 23*(1), 63–72. https://doi.org/10.1016/j.rasd.2015.11.006

Crais, E., & Ogletree, B. T. (2016). Prelinguistic communication development. In D. Keen, H. Meadan, N. C. Brady, & J. W. Halle (Eds.), *Prelinguistic and minimally verbal communicators on the autism spectrum* (pp. 9–32). Springer. https://doi.org/10.1007/978-981-10-0713-2_2

Douglas, S. N., & Gerde, H. K. (2019). A strategy to support the communication of students with autism spectrum disorder. *Intervention in School and Clinic, 55*(1), 32–38. https://doi.org/10.1177/1053451219833021

Drew, A., Baird, G., Taylor, E., Milne, E., & Charman, T. (2007). The Social Communication Assessment for Toddlers with Autism (SCATA): An instrument to measure the frequency, form and function of communication in toddlers with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 37*(4), 648–666. https://doi.org/10.1007/s10803-006-0224-9

Dubin, A. H., & Lieberman-Betz, R. G. (2020). Naturalistic interventions to improve prelinguistic communication for children with autism spectrum disorder: A systematic review. *Review Journal of Autism and Developmental Disorders, 7*(2), 151–167. https://doi.org/10.1007/s40489-019-00184-9

Duker, P. C. (1999). The verbal behavior assessment scale (VerBAS): Construct validity, reliability, and internal consistency. *Research in Developmental Disabilities, 20*(5), 347 353. https://doi.org/10.1016/s0891-4222(99)00016-5

Durand, V. M., & Moskowitz, L. (2015). Functional communication training: Thirty years of treating challenging behavior. *Topics in Early Childhood Special Education, 35*(2), 116–126. https://doi.org/10.1177/0271121415569509

Esch, B. E., LaLonde, K. B., & Esch, J. W. (2010). Speech and language assessment: A verbal behavior analysis. *The Journal of Speech and Language Pathology and Applied Behavior Analysis, 5*(2), 166. https://doi.org/10.1037/h0100270

Evans, P. L. C., & Spittle, J. A. (1981). The development and use of a Premack symbol system in improving the communication skills of two children with learning difficulties. *Educational Psychology, 1*, 87–99.

Ferreri, S. J., & Plavnick, J. B. (2011). A functional analysis of gestural behaviors emitted by young children with severe developmental disabilities. *The Analysis of Verbal Behavior, 27*(1), 185–190. https://doi.org/10.1007/bf03393101

Foxx, R. M., Schreck, K. A., Garito, J., Smith, A., & Weisenberger, S. (2004). Replacing the echolalia of children with autism with functional use of verbal labeling. *Journal of Developmental and Physical Disabilities, 16*, 307–320.

Fuentes, J., Hervas, A., Howlin, P., & ESCAP ASD Working Party. (2021). ESCAP practice guidance for autism: A summary of evidence-based recommendations for diagnosis and treatment. *European Child & Adolescent Psychiatry, 30*, 961–984. https://doi.org/10.1007/s00787-020-01587-4

Ganz, J. (2014). *Aided augmentative communication for individuals with autism spectrum disorders*. Springer. https://doi.org/10.1007/987-1-4939-0814-1

Gerow, S., Davis, T., Radhakrishnan, S., Gregori, E., & Rivera, G. (2018). Functional communication training: The strength of evidence across disabilities.

Exceptional Children, 85(1), 86–103. https://doi.org/10.1177/0014402918793399
Goldberg, W. A., Jarvis, K. L., Osann, K., Laulhere, T. M., Straub, C., Thomas, E., et al. (2005). Brief report: Early social communication behaviors in the younger siblings of children with autism. *Journal of Autism and Developmental Disorders, 35*(5), 657–664. https://doi.org/10.1007/s10803-005-0009-6
Goldsmith, T. R., LeBlanc, L. A., & Sautter, R. A. (2007). Teaching intraverbal behavior to children with autism. *Research in Autism Spectrum Disorders, 1*(1), 1–13. https://doi.org/10.1016/j.rasd.2006.07.001
Horner, R. H., & Day, H. M. (1991). The effects of response efficiency on functionally equivalent competing behaviors. *Journal of Applied Behavior Analysis, 24*(4), 719–732. https://doi.org/10.1901/jaba.1991.24-719
Hume, K., Steinbrenner, J. R., Odom, S. L., Morin, K. L., Nowell, S. W., Tomaszewski, B., Szendrey, S., McIntyre, N. S., Yücesoy-Özkan, S., & Savage, M. N. (2021). Evidence-based practices for children, youth, and young adults with autism: Third generation review. *Journal of Autism and Developmental Disorders, 51*(11), 4013–4032. https://doi.org/10.1007/s10803-020-04844-2
Ingvarsson, E. T. (2016). Tutorial: Teaching verbal behavior to children with ASD. *International Electronic Journal of Elementary Education, 9*(2), 433–450. Retrieved from https://iejee.com/index.php/IEJEE/article/view/168
Iverson, J. M., & Wozniak, R. H. (2016). Transitions to intentional and symbolic communication in typical development and in autism spectrum disorder. In D. Keen, H. Meadan, N. C. Brady, & J. W. Halle (Eds.), *Prelinguistic and minimally verbal communicators on the autism spectrum* (pp. 51–72). Springer. https://doi.org/10.1007/978-981-10-0713-2_4
Jones, E. A., & Carr, E. G. (2004). Joint attention in children with autism: Theory and intervention. *Focus on Autism and Other Developmental Disabilities, 19*(1), 13–26. https://doi.org/10.1177/10883576040190010301
Kasari, C., Freenman, S., & Paperella, T. (2006). Joint attention and symbolic play in young children with autism: A randomized controlled intervention study. *Journal of Child Psychology and Psychiatry, 47*(6), 611–620. https://doi.org/10.1111/j.1469-7610.2005.01567.x
Kasari, C., Brady, N., Lord, C., & Tager-Flusberg, H. (2013). Assessing the minimally verbal school-aged child with autism spectrum disorder. *Autism Research, 6*(6), 479–493. https://doi.org/10.1002/aur.1334
Keen, D., Meadan, H., Brady, N. C., & Halle, J. W. (Eds.). (2016). *Prelinguistic and minimally verbal communicators on the autism spectrum*. Springer. https://doi.org/10.1007/978-981-10-0713-2
Lang, R., & Sturmey, P. (Eds.). (2021). *Adaptive behavior strategies for individuals with intellectual and developmental disabilities*. Springer. https://doi.org/10.1007/978-3-030-66441-1
LeBlanc, L. A., Esch, J., Sidener, T. M., & Firth, A. M. (2006). Behavioral language interventions for children with autism: Comparing applied verbal behavior and naturalistic teaching approaches. *Analysis of Verbal Behavior, 22*, 49–60.
Lerman, D. C., Parten, M., Addison, L. R., Vorndran, C. M., Volkert, V. M., & Kodak, T. (2005). A methodology for assessing the functions of emerging speech in children with developmental disabilities. *Journal of Applied Behavior Analysis, 38*(3), 303–316. https://doi.org/10.1901/jaba.2005.106-04
Lerman, D. C., Valentino, A. L., & LeBlanc, L. A. (2016). Discrete trial training. In R. Lang, T. B. Hancock, & N. Singh (Eds.), *Early intervention for young children with autism spectrum disorder* (pp. 47–83). Springer. https://doi.org/10.1007/978-3-319-30925-5_3
Linscheid, T. R. (1999). Commentary: Response to empirically supported treatments for feeding problems. *Journal of Pediatric Psychology, 24*(3), 215–216. https://www.unmc.edu/media/mmi/behavioral/pdf/studenttrainingarticles/commentaryresponseempiricallysupported.pdf
Lovaas, O. I. (1977). *The autistic child: Language development through behavior modification*. Irvington.
Lovaas, O. I., Berberich, J. P., Perloff, B. F., & Schaeffer, B. (1966). Acquisition of imitative speech by schizophrenic children. *Science, 151*, 705–707.
Lovaas, O. I., Koegel, R., Simmons, J. Q., & Long, J. S. (1973). Some generalization and follow-up measures on autistic children in behavior therapy. *Journal of Applied Behavior Analysis, 6*(1), 131–165. https://doi.org/10.1901/jaba.1973.6-131
Makrygianni, M. K., Gena, A., Katoudi, S., & Galanis, P. (2018). The effectiveness of applied behavior analytic interventions for children with autism spectrum disorder: A meta-analytic study. *Research in Autism Spectrum Disorders, 51*(1), 18–31. https://doi.org/10.1016/j.rasd.2018.03.006
Matson, J. L., Terlonge, C., & Minshawi, N. F. (2008). Children with intellectual disabilities. In R. J. Morris & T. R. Kratochwill (Eds.), *The practice of child therapy* (4th ed., pp. 337–361). Lawrence Erlbaum.
McGreevy, P., Fry, T., & Cornwall, C. (2012). *Essential for living scoring manual*. McGreevy. https://www.behaviorchange.com
Michael, J. (1984). Verbal behavior. *Journal of the Experimental Analysis of Behavior, 42*(3), 363–376. https://doi.org/10.1901/jeab.1984.42-363
Miller, M., Losif, A.-M., Hill, M., Young, G. S., Schwichtenberg, A. J., & Ozonoff, S. (2017). Response to name in infants developing autism spectrum disorder: A prospective study. *Journal of Pediatrics, 183*, 141–146.e1. https://doi.org/10.1016/j.jpeds.2016.12.071
Mirenda, P., & Iacono, T. (Eds.). (2009). *Autism spectrum disorders and AAC*. Paul H. Brookes.
Mitteer, D. R., Randall, K. R., Van Winkle, L. J., & Greer, B. D. (2020). Incorporating discriminative stimuli into functional communication training with augmentative and alternative communication devices: A tutorial.

Augmentative and Alternative Communication, 36(1), 63–70. https://doi.org/10.1080/07434618.2020.1731761
Monteiro, S. A., Dempsey, J., Berry, L. N., Voigt, R. G., & Goin-Kochel, R. P. (2019). Screening and referral practices for autism spectrum disorder in primary pediatric care. *Pediatrics, 144*(4), e20183326. https://doi.org/10.1542/peds.2018-3326
National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2*. Retrieved from: https://www.nationalautismcenter.org/national-standards-project/phase-2/
National Research Council. (2001). *Educating children with autism*. National Academy Press.
Normand, M. P., Severtson, E. S., & Beavers, G. A. (2008). A functional analysis of non-vocal verbal behavior of a young child with autism. *The Analysis of Verbal Behavior, 24*(1), 63–67. https://doi.org/10.1007/bf03393057
Padilla, K. L. (2020). Global assessment use and practices in applied behavior analysis: Surveying the field. *Research in Autism Spectrum Disorders*. https://doi.org/10.1016/j.rasd.2020.101676
Padilla, K. L., & Akers, J. S. (2021). Content validity evidence for the Verbal Behavior Milestones Assessment and Placement Program. *Journal of Autism and Developmental Disorders*, 1–13. https://doi.org/10.1007/s10803-020-04864-y
Parker-McGowan, Q., Chen, M., Reichle, J., Pandit, S., Johnson, L., & Kreibich, S. (2014). Describing treatment intensity in milieu teaching interventions for children with developmental disabilities: A review. *Language, Speech, and Hearing Services in Schools, 45*(4), 351–364. https://doi.org/10.1044/2014_LSHSS-13-0087
Partington, J. W. (2010). *The assessment of basic language and learning skills-revised*. Behavior Analysts, Inc..
Partington, J. W., Bailey, A., & Partington, S. W. (2018a). A pilot study on patterns of skill development of neurotypical children as measured by the ABLLS-R: Implications for educational programming for children with autism. *International Journal of Contemporary Education, 1*(2), 10.11114/ijce.v1i2.3619.
Partington, J. W., Bailey, A., & Partington, S. W. (2018b). A pilot study examining the test–retest and internal consistency reliability of the ABLLS-R. *Journal of Psychoeducational Assessment, 36*(4), 405–410. https://doi.org/10.1177/0734282916678348
Pierce, K., Gazestani, V., Bacon, E., Courchesne, E., Cheng, A., Carter-Barnes, C., et al. (2021). *Get SET Early* to identify and treatment refer autism spectrum disorder at 1 year and discover factors that influence early diagnosis. *The Journal of Pediatrics, 236*, 179–188. https://doi.org/10.1016/j.jpeds.2021.04.041
Pituch, K. A., Green, V. A., Didden, R., Lang, R., O'Reilly, M. F., Lancioni, G. E., & Sigafoos, J. (2011). Parent reported treatment priorities for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(1), 135–143. https://doi.org/10.1016/j.rasd.2010.03.003
Reichle, J., & Wacker, D. P. (2017). *Functional communication training for problem behavior*. Guilford Press.
Reichle, J., O'Neill, R. J., & Johnston, S. S. (2021). Advances in AAC intervention: Some contributions related to applied behavior analysis. *Augmentative and Alternative Communication, 37*(3), 206–216. https://doi.org/10.1080/07434618.2021.1962405
Roche, L., Adams, D., & Clark, M. (2021). Research priorities of the autism community: A systematic review of key stakeholder perspectives. *Autism, 25*(2), 336–348. https://doi.org/10.1177/1362361320967790
Rogers, S. J., Dawson, G., & Vismara, L. A. (2012). *An early start for your young child with autism: Using everyday activities to help kids connect, communicate, and learn*. Guilford Press.
Rose, V., Trembath, D., Keen, D., & Paynter, J. (2016). The proportion of minimally verbal children with autism spectrum disorder in a community-based early intervention programme. *Journal of Intellectual Disability Research, 60*(5), 464–477. https://doi.org/10.1111/jir.12284
Rutherford, M., Baxter, J., Grayson, Z., Johnston, L., & O'Hare, A. (2020). Visual supports at home and in the community for individuals with autism spectrum disorders: A scoping review. *Autism, 24*(2), 447–469. https://doi.org/10.1177/1362361319871756
Schlosser, R. W., & Koul, R. (2015). Speech output technologies in interventions for individuals with autism spectrum disorders: A scoping review. *Augmentative and Alternative Communication, 31*(4), 285–309. https://doi.org/10.3109/07434618.2015.1063689
Schlosser, R. W., & Wendt, O. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: A systematic review. *American Journal of Speech-Language Pathology, 17*, 212–230. https://doi.org/10.1044/1058-0360(2008/021)
Schlosser, R. W., Laubscher, E., Sorce, J., Koul, R., Flynn, S., Hotz, L., Abramson, J., Fadie, H., & Shane, H. (2013). Implementing directives that involve prepositions with children with autism: A comparison of spoken cues with two types of augmented input. *Augmentative and Alternative Communication, 29*(2), 132–145. https://doi.org/10.3109/07434618.2013.784928
Schlosser, R. W., Brock, K. L., Koul, R., Shane, H., & Flynn, S. (2019). Does animation facilitate understanding of graphic symbols representing verbs in children with autism spectrum disorder? *Journal of Speech Language, and Hearing Research, 62*(4), 965–978. https://doi.org/10.1044/2018_JSLHR-L-18-0243
Schlosser, R. W., Shane, H. C., Allen, A. A., Benz, A., Cullen, J., O'Neill, L., Chiesa, L., Minori-Dinneen, L., Koul, R., & Pasupathy, R. (2020). Coaching a school team to implement the Visual Immersion System™ in a classroom for children with autism spectrum disorder: A mixed methods proof-of-concept study. *Advances*

in Neurodevelopmental Disorders, 4(4), 447–470. https://doi.org/10.1007/s41252-020-00176-5

Schlosser, R. W., Shane, H. C., Allen, A. A., Yu, C., O'Brien, A. M., Cullen, J., Benz, A., O'Neil, L., Chiesa, L., & Miori-Dinneen, L. (2021). Implementing the Visual Immersion System™ in a classroom for children with autism spectrum disorder: Challenges and solutions. In B. T. Ogletree (Ed.), *Augmentative and alternative communication: Challenges and solutions* (pp. 283–311). Plural Publishing.

Schreibman, L., Dawson, G., Stahmer, A. C., Landa, R., Rogers, S. J., McGee, G. G., et al. (2015). Naturalistic developmental behavioral interventions. Empirically validated treatments for autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*(8), 2411–2428. https://doi.org/10.1007/s10803-015-2407-8

Shane, H. C., Laubscher, E., Schlosser, R. W., Fadie, H. L., Sorce, J. F., Abramson, J. S., Flynn, S., & Corley, K. (2015). *Enhancing communication for individuals with autism: A guide to the Visual Immersion System*™. Paul H. Brookes Publishing Co.

Sigafoos, J. (2021). Teaching communication skills to individuals with intellectual and developmental disabilities. In R. Lang & P. Sturmey (Eds.), *Adaptive behavior strategies for individuals with intellectual and developmental disabilities: Evidence-based practices across the lifespan* (pp. 73–102). Springer. https://doi.org/10.1007/978-3-030-66441_4

Sigafoos, J., Schlosser, R. W., O'Reilly, M. F., & Lancioni, G. E. (2009). Communication. In J. L. Matson (Ed.), *Applied behaviour analysis for children with autism spectrum disorders* (pp. 109–127). Springer. https://doi.org/10.1007/978-1-4419-0088-3_6

Sigafoos, J., O'Reilly, M. F., Lancioni, G. E., Carnett, A., Bravo, A., Rojeski, L., & Halle, J. W. (2016). Functional assessment of problematic forms of prelinguistic behavior. In D. Keen, H. Meadan, N. C. Brady, & J. W. Halle (Eds.), *Prelinguistic and minimally verbal communicators on the autism spectrum* (pp. 121–145). Springer. https://doi.org/10.1007/978-981-10-0713-2_7

Sigafoos, J., Carnett, A., O'Reilly, M. F., & Lancioni, G. E. (2019). Discrete trial training: A structured learning approach for children with ASD. In S. G. Little & A. Akin-Little (Eds.), *Behavioral interventions in schools: Evidence-based positive strategies* (pp. 227–243). American Psychological Association. https://doi.org/10.1037/0000126-013

Skinner, B. F. (1957). *Verbal behavior*. Prentice-Hall.

Snell, M. E., Chen, L. Y., & Hoover, K. (2006). Teaching augmentative and alternative communication to students with severe disabilities: A review of intervention research 1997–2003. *Research and Practice for Persons with Severe Disabilities, 31*, 203–214.

Stone, W., & Yoder, P. (2001). Predicting spoken language level in children with autism spectrum disorders. *Autism, 5*(4), 341–361. https://doi.org/10.1177/1363361301005004002

Sundberg, M. L. (2014). *VB-MAPP: Verbal behavior milestones assessment and placement program: A language and social skills assessment program for children with autism or other developmental disabilities*. AVB Press.

Sundberg, M. L., & Partington, J. W. (1998). *Teaching language to children with autism or other developmental disabilities*. Behavior Analysts, Inc..

Syriopoulou-Delli, C. K., & Eleni, G. (2021). Effectiveness of different types of augmentative and alternative communication (AAC) in improving communication skills and in enhancing the vocabulary of children with ASD: A review. *Review Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s40489-021-00269-4

Tiede, G., & Walton, K. M. (2019). Meta-analysis of naturalistic developmental behavioral interventions for young children with autism spectrum disorder. *Autism, 23*(8), 2080–2095. https://doi.org/10.1177/1362361319836371

Tupou, J., van der Meer, L., Waddington, H., & Sigafoos, J. (2019). Preschool interventions for children with autism spectrum disorder: A review of effectiveness studies. *Review Journal of Autism and Developmental Disorders, 6*(4), 381–402. https://doi.org/10.1007/s40489-019-00170-1

Tupou, J., Waddington, H., & Sigafoos, J. (2020). Evaluation of a brief teacher coaching program for delivering an early intervention program to preschoolers with autism spectrum disorder. *Infants & Young Children, 33*(4), 259–282. https://doi.org/10.1097/IYC.0000000000000174

Usry, J., Partington, S. W., & Partington, J. W. (2018). Using expert panels to examine the content validity and inter-rater reliability of the ABLLS-R. *Journal of Developmental and Physical Disabilities, 30*(1), 27–38. https://doi.org/10.1007/s10882-017-9574-9

Walker, V. L., Lyon, K. J., Loman, S. L., & Sennott, S. (2018). A systematic review of Functional Communication Training (FCT) interventions involving augmentative and alternative communication in school settings. *Augmentative and Alternative Communication, 34*(2), 118–129. https://doi.org/10.1080/07434618.2018.1461240

Williams, D. L., Siegel, M., Masefsky, C. A., & for the Autism and Developmental Disorders Inpatient Research Collaborative (ADDIRC). (2018). Problem behaviors in autism spectrum disorders: Association with verbal ability and adapting coping skills. *Journal of Autism and Developmental Disorders, 48*(11), 3668–3677. https://doi.org/10.1007/s10803-017-3179-0

10 Some Important Repertoires to Consider When Training Autism Interventionists

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Introduction

Autism spectrum disorder (ASD) is marked by impairments in social and communication skills as well as restricted and/or repetitive behaviors and interests (American Psychiatric Association, 2013). It has been reported that 1 in 59 children living in the United States are diagnosed with ASD (Baio et al., 2018), which has also been reported globally (Christensen et al., 2016). Quality, intensive behavioral intervention, based on the principles of applied behavior analysis

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(ABA), has been demonstrated to lead to the development of many important skills and an overall improved quality of life for autistics/individuals diagnosed with autism spectrum disorder[1] (ASD; Smith et al., 2000). For instance, many autistics/individuals diagnosed with ASD who begin early intensive behavioral intervention (EIBI) with limited language and social skills can emerge from intervention with sophisticated communicative repertoires and meaningful friendships (Leaf et al., 2016).

To provide the most effective ABA-based intervention for autistics/individuals diagnosed with ASD, it is essential that the intervention is implemented by highly skilled interventionists (Leaf et al., 2016). As a result, professionals in the ABA field have long been concerned about ensuring that interventionists are highly skilled at providing quality intervention by determining essential repertoires, evaluating the most effective methods to develop these essential repertoires, and developing standards to ensure these essential repertoires are present. As early as the 1960s, prominent leaders in the field of ABA began developing university programs to train behavior analysts (e.g., Western Michigan, University of Kansas, University of California at Los Angeles, Southern Illinois University, University of Washington; Baer, 2001). Many behavior analysts trained in research and practice (Davison, 1998; Nathan, 2000) began to emerge from these university settings. Parallel to the emergence of behavior analysts from universities, there was an increase in the number of empirical studies evaluating training methods for professionals to implement high quality interventions and procedures. The development of university programs paired with an increase in empirical investigations was indicative of the concern for quality in the training of behavior analysts during the early development of the field.

As the field of ABA-based interventions for autistics/individuals diagnosed with ASD continued to grow, professionals began to discuss the need for standards to ensure that individuals received quality, effective ABA-based interventions in addition to protection from harmful or inadequate intervention. Van Houten and colleagues' (1988) manuscript marked a seminal step in ensuring behavior analytic inventions protected consumer rights. Specifically, Van Houten and colleagues described six rights to which individuals with developmental disabilities (e.g., ASD) or intellectual disabilities are entitled when receiving behavior analytic interventions. One of these is the right "to treatment by a competent behavior analyst" (Van Houten et al., 1988, p. 382). Van Houten and colleagues described competent behavior analysts as,

> …possess[ing] appropriate education and experience. The behavior analyst's academic training reflects thorough knowledge of behavioral principles, methods of assessment and treatment, research methodology, and professional ethics. Clinical competence also requires adequate practicum training and supervision, including experience with the relevant client population. (p. 382)

As discussions of consumers' rights and effective treatment continued, the development of the Behavior Analyst Certification Board (BACB) came to fruition. After much discussion in the literature and public forums, the BACB was officially created in 1998. Initially, two levels of certification were developed: Board Certified Behavior Analysts (BCBAs), who were generally in charge of case supervision (although direct work could occur) and Board Certified Assistant Behavior Analysts (BCaBAs), who were, for the most part, in charge of direct intervention. Within these two levels of certification, task lists were developed for the skills that professionals were required to demonstrate (or at the very least answer related questions correctly on a multiple-choice exam) to be considered minimally competent.

The task lists for BCBAs and BCaBAs were created based upon professional opinion (e.g., commentaries) and the opinions of subject matter

[1]This terminology was selected to adhere to the seventh edition of the American Psychological Association Publication Manual and to be inclusive of those who prefer person-first as well as identity-first language.

experts. Moore and Shook (2001) provided a summary of some skills assessed on an early BACB examination. Items were collected from the BACB website and some broad skill areas included theoretical and conceptual understanding, behavioral assessment, establishing behavior, strengthening behavior, weakening behavior, and cultural and social issues. Each broad area included more specific skill sets (e.g., basic principles of behavior, measurement, transfer of technology). It is important to note, however, that the skills Moore and Shook outlined (i.e., the skills listed on the BACB website) were meant for all behavior analytic practitioners, not solely for those providing intervention for autistics/individuals diagnosed with ASD.

The skills Moore and Shook (2001) initially discussed have been revised over time, and different levels of competencies have been developed. For instance, the skills on the BCBA and BCaBA task list have been refined and expanded and in 2014 an additional certification that more closely represented the level of a direct implementer was developed (i.e., the Registered Behavior Technician; RBT). As such, a new task list specific to the RBT credential was necessary. The task list for an RBT included broad skill areas such as measurement, assessment, skill acquisition, behavior reduction, documentation and reporting, professional conduct, and scope of practice. Within each broad skill area were more specific skills outlined for training and assessment purposes (e.g., "Describe the behavior and environment in observable and measurable terms;" Behavior Analysis Certification Board, 2018, p. 1). Similar to the BCBA and BCaBA, the RBT credential was designed for all behavior analytic practitioners, not just those providing intervention for autistics/individuals diagnosed with ASD. Thus, the majority of the task list content does not relate specifically to the provision of behavior analytic services for autistics/individuals diagnosed with ASD. However, it should be noted that, similar to BCaBAs and BCBAs, the majority of RBTs report ASD as their primary area of professional emphasis (Behavior Analyst Certification Board, n.d.), and it was this population that inspired the development of the implementer credential.

McGee and Morrier (2005) attempted to narrow the focus of essential skills for behavior interventionists as it specifically applies to behavior analytic intervention for autistics/individuals diagnosed with ASD. Within McGee and Morrier's discussion of how to prepare autism specialists, they provided minimal knowledge areas for new staff. While the areas discussed are too extensive to be included here (we encourage the reader to contact the original source), some general goal areas discussed included safety, ethics, organizational citizenship, professionalism, big picture overview of the program, dissemination, and distinctive features of the program model. McGee and Morrier noted that "the specific skills that providers must be prepared in vary substantially according to the provider group and goals for project impact…[however] curriculum for training autism intervention specialists must address certain global intervention skills" (p. 1140). Ultimately, McGee and Morrier illustrated that the skills necessary for a highly skilled interventionist providing intervention for autistics/individuals diagnosed with ASD are vast, and encompass ethical obligations and safety in addition to clinical methods.

More recently, Leaf et al. (2017) expanded upon training competencies, and these were then updated by Leaf et al. (2021). Leaf et al. (2017, 2021) discussed some concerns with the standards for the RBT® credential as it applies to intervention for autistics/individuals diagnosed with ASD.[2] While the concerns Leaf and colleagues presented were many, one focused on the lack of thoroughness of the RBT® task list. Some skills Leaf and colleagues noted as missing from the RBT task list included data interpretation, understanding curriculum development, critical thinking and skepticism (e.g., identifying fad treatments), behavioral skills training, and leading or supporting group instruction. Leaf et al. (2016) provided a parallel discussion of essential

[2]The reader should also contact the response to Leaf et al. (2017) provided by Carr and colleagues (2017) with respect to concerns about the RBT credential.

skills when discussing ABA as a progressive science and noted,

> Appropriately trained behavior interventionists are truly analysts; rather than merely carrying out a protocol, they must analyze behavior and environment interactions moment by moment. Analysts take into account critical learning variables, such as the child's current motivation, responsiveness, and behaviors that may signal emotional states and contingencies. They assess the current functions of behavior and determine if disruptive behaviors are potentially operant or respondent. They identify the optimal shaping and prompting strategies based upon past and present performance as well as the importance and difficulty of the tasks. Critical factors also include the child's nonverbal behaviors (e.g., facial expressions and body language) and the child's physical state. In effect, during intervention they are shaped by clear goal specification, knowledge of principles, scientific method, and current environmental contingencies, instead of rigid adherence to unresponsive protocols. They are able to achieve more rapid change in behavior by following the *intent* of the protocol rather than being bound to the *letter* of the protocol. (p. 721)

Leaf and colleagues (2016) continued to discuss some elements of a progressive approach to ABA, all of which are relevant to determining the essential skills in which any highly skilled autism interventionist should be proficient.

It is clear from the aforementioned literature that while there may be disagreement about the essential repertoires for highly skilled interventionists and how to ensure those repertoires are present, there is agreement that ensuring interventionists are highly skilled is of the utmost importance. This literature also illustrates the need for continued discussion in this area. The purpose of this chapter is to outline *some* repertoires that should be considered while training individuals to provide ABA-based intervention for autistics/individuals diagnosed with ASD. The repertoires described here differ or expand upon those included elsewhere (e.g., certification task lists); this should not discount those repertoires outlined in other sources, but, rather, supplement and expand them. It should be noted from the outset that the repertoires included within this chapter are not meant to be exhaustive, and it is unlikely that an exhaustive list can be developed across all interventionists and contexts. What is included here should be modified based on individual and organizational needs and should evolve over time. Also, the repertoires included within this chapter are not provided in order of importance, as it is likely that an interventionist will need to exemplify each of these characteristics to some extent and that each of them could be relevant at different points in intervention. It is also critical to note that the repertoires included within this chapter are done so in the context of the individual directly implementing the intervention and not those who may be providing supervision.

Repertoires

Understanding of Human Development and ASD

The most commonly obtained certifications within behavior analysis (i.e., RBT, BCaBA, BCBA) were developed with respect to applications of behavior analysis more broadly, as opposed to being developed to focus specifically on applications for autism intervention. As a result, the task lists that outline the skills required to obtain those certifications do not require information specific to human development and ASD. ASD, however, can present specific challenges of which an interventionist should be knowledgeable in order to be highly effective (e.g., impairments in social and communication skills as well as restricted and/or repetitive behaviors and interests; American Psychiatric Association, 2013). This would include, but is not limited to, an understanding of how an ASD diagnosis is obtained, how ASD compares to typical development and other developmental disabilities, common comorbid disorders, commonly used assessments/screening tools, challenges of parents/caregivers and siblings, and a general understanding of the evidence base supporting behavioral intervention for autistics/individuals diagnosed with ASD. A thorough understanding of ASD and specific challenges associated with ASD will likely lead to many benefits throughout the course of intervention.

When working to build skill sets and address skill deficits, it is pertinent to understand what is developmentally appropriate given the current skill set, chronological age, and culture of the individual. This will ensure that the skills being taught are socially valid for the individual within their environment. Additionally, a lack of understanding of typical developmental progressions by the interventionist may inadvertently lead to expectations being set for the learner for which they have not mastered the prerequisite skills. Learning is a process of growing complexity where each new objective should be tailored to the learner depending on their mastery of earlier goals and what is socially significant for their environment. If the complexity does not advance or critical prerequisites are skipped, learning can stall.

In the past, interventionists have sometimes taught well beyond the chronological age. Early EIBI interventionists supported this, as it sometimes allowed for compensatory learning strategies and highlighted the child's strengths (e.g., Lovaas, 1987). However, preparing the learner for inclusive environments implies a sensitivity to the skills that will be needed and to the repertoires of peers. Understanding developmental progression ensures that targets are appropriate to the setting, and that the learner will be equipped for the activities likely to occur. The cultural expectations for the child's developmental level are also critical to consider within these contexts to ensure that the expectations are understood by the individuals establishing the learning opportunities.

Fun and Engaging

One area within autism intervention that has received much attention is the development of positive rapport between an interventionist and a client (e.g., McLaughlin & Carr, 2005; Shireman et al., 2016). Rapport has been described as the quality of the relationship between two individuals (McLaughlin & Carr, 2005). The development of a positive relationship can help promote acquisition of new skills and reduce the likelihood of undesired behavior. Interventionists with positive rapport typically keep the client engaged more frequently and would typically be labeled as "fun" by an outside observer. Therefore, highly skilled interventionists establish and maintain a positive rapport that leads to fun and engaging interactions between themselves and the learner. The quality of this relationship has been measured in at least two objective ways. One, through the use of a preference assessment (e.g., Leaf et al., 2012) in which two or more interventionists are presented simultaneously and the learner is instructed to select one with whom to play. The interventionist chosen first across multiple presentations could be described as having positive rapport. Two, positive or negative rapport could be measured through collecting data on the frequency of approaches (i.e., moving toward the interventionist) and retreats (i.e., moving away from the interventionist) during a period of time. An interventionist with more approaches than retreats may be said to have a positive rapport. No matter the measure, highly skilled interventionists demonstrate fun, engaging, and positive relationships with learners for whom they provide intervention. This is also important for the concept of assent—to what extent is the learner willingly engaging in the process of learning with this interventionist. Fabrizio (2005) emphasized the need to ensure assent and recommended taking continuous data on demonstrations of assent and on instances of assent withdrawal. These data are vital to ensuring a positive and compassionate environment for the learner, build the learner's agency in intervention, and create a mechanism for the learner's voice and preferences to be honored.

In addition to more approaches and fewer retreats from the interventionist, fun and engaging interventionists present other benefits to quality intervention. Interventionists who are fun and engaging are likely to be more socially connected with the individuals with whom they provide intervention. This social connectedness can lead to more common use of social events as reinforcers (e.g., high fives, smiles, praise). Given the social deficits common with an autism diagnosis, social events functioning as reinforcers can have numerous benefits with respect to generalization and maintenance of learned skills (Leaf et al., 2016). Additionally, the inclusion of enjoyable social events provides the additional benefit of the interventionist modeling appropriate social skills for the learner. Given the social deficits common with an ASD diagnosis, any opportunity to engage socially and encourage advancement of social skills should be captured. Doing so during times of fun and excitement, such as while accessing reinforcement, enhances the likelihood of strengthening those social skills and motivation to engage further. Furthermore, when the interventionist is fun and engaging, it is probable that there is less of a likelihood that challenging behaviors maintained by escape may be engendered. When an interventionist who is fun and engaging is part of an activity, the client may be less motivated to escape that activity.

While positive rapport is perceived as being fun, or results in more approaches than retreats, highly skilled interventionists continue to maintain this rapport when the client encounters challenges. Despite presentation of difficult antecedents or tasks, the client continues to persist in the desired behavior and may even turn to the interventionist for support or acknowledgement of facing struggles. Clients with well-developed language skills may encounter difficult situations when away from the interventionist but may seek support or guidance because they value input from the interventionist.

Receptive to Feedback

One characteristic that distinguishes a highly skilled interventionists from other interventionists is receptiveness to feedback. Receptiveness to feedback describes an interventionist who implements corrective feedback immediately, seeks out feedback on their performance, and the behavior change from corrective feedback is maintained and generalized across learners and skills. This contrasts with interventionists who never seek feedback or who repeatedly receive feedback without observable change. This also contrasts with interventionists who will agree with the feedback but then never make the respective behavior change once the feedback is provided. Given the time sensitivity of effective intervention and the typically limited resources of supervisor presence, it is imperative that interventionists apply feedback effectively and maintain that feedback to ensure that the learner is accessing as high quality of services as possible.

Changes in performance do not always have to come from feedback from a supervisor. Highly skilled interventionists are also responsive to the client's performance, and, therefore, make changes based on this feedback from the client. Ultimately, highly skilled interventionists demonstrating receptiveness to supervisor feedback and responsivity to client behavior are likely to have more expedited training times, advanced skills, and be effective with a wide range of individuals. Such responsiveness also builds trust and rapport, as the client and trainers see the utility of providing feedback and experience intervention as a reciprocal, joint endeavor with mutually invested participants.

Systematic

Highly skilled interventionists approach all teachable moments, contrived or captured, in a systematic way. At the least this means (1) developing a plan for teaching the skill (e.g., selecting a teaching approach appropriate to the skill and learner), (2) constructing a task analysis of the skill appropriate to the individual (i.e., breaking larger skills down into the component parts), (3) only teaching aspects of the skill for which the learner is prepared before increasing complexity, and (4) determining a plan for generalization, maintenance, and expansion (i.e., identifying stimuli that occasion the skill in the natural environment and the contingencies that maintain it). Systematic is not to be confused with an inflexible adherence to a task analysis or protocol. Rather, an interventionist is systematic in that they develop a plan prior to a teaching session and identify the variables that may contribute or impede acquisition of a skill, as opposed to entering a teaching session unprepared for how and what to teach.

This approach by highly skilled interventionists has been referred to in the literature as a structured, yet flexible approach (Leaf et al., 2016). There are numerous benefits of taking this approach with respect to intervention for autistics/individuals diagnosed with ASD. For instance, developing a structured, systematic plan during each session permits the interventionist to break skills down and teach their component parts in a more effective manner. This avoids developing skills with missing essential components (i.e., "swiss cheese knowledge") or teaching skills the learner is not prepared to learn (e.g., teaching addition prior to accurate identification of numbers). Developing a systematic plan also permits the interventionist to assess the learner's entry level repertoire and use that as a guide when carrying out the plan (Goldiamond, 1974). Again, this avoids targeting behaviors for which the learner may not be ready as well as helping to ensure the learner contacts sufficient reinforcement early in the learning process.

Adaptive/Flexible

Although highly skilled interventionists must be systematic, they must also be adaptive and flexible in their approach. In being flexible, an interventionist must have a well-developed *clinical judgement* repertoire that permits in-the-moment analysis of learner and environmental variables to inform changes to the intervention and goals (Leaf et al., 2016). This analysis, and changes to the interventionist's behavior as a result, could occur on a moment-to-moment basis. Being systematic, yet adaptable and flexible, is analogous to the great accomplishments in many other fields (e.g., NFL quarterback, musician). For example, quarterbacks have a systematic game plan of what to do on any given play, but they can "call an audible" and make changes to the play given the environmental situation (e.g., what the defense is doing). These changes are only possible when the quarterback analyzes a variety of variables in-the-moment (e.g., success of past plays, defensive placement, location on the field). A similar example occurs when a musician has a set list planned for a show. However, during that set list, a musician may change the tempo or add alterations to a song given the responsiveness of the audience. The musician may even add or omit songs from the set list given requests from the audience, all decisions made in-the-moment to maximize engagement and positive affect with the audience. Each of these examples highlights the nuanced analysis that is continually occurring during the context itself and demonstrates how individualization characterizes each and every interaction or event.

While clinical judgement may sound mentalistic to some, it is meant to describe an observable and measurable skill set. That is, highly skilled interventionists analyze and respond to current motivating operations affecting learner responding, the learner's responsiveness to presumed reinforcers and punishers, presumed functions of behavior, whether disruptive behaviors are potentially operant or respondent, the learner's past and present responses to various prompts, among many others (Leaf et al., 2016). As such, the main sources of control for a highly skilled interventionist's behavior are environmental variables affecting the learner's behavior and the learner's behavior itself as opposed to being responsive to a scripted protocol.

Analytic

Similar to being systematic, highly skilled interventionists embody the analytic dimension of ABA (Baer et al., 1968, 1987). A highly skilled interventionist readily identifies events that are responsible for the behavior change as well as events that are not responsible for the behavior change. This can involve carefully analyzing variables to determine if functional relationships exist between an environmental variable and the behavior change as well as analyzing if a skill improving, if an event/item is an effective reinforcer, if a prompt is effective and if it needs to be faded or increased, and the optimal number of trials to run, just to name a few. Often this analysis occurs in-the-moment and helps to identify if a skill has met predetermined mastery criteria or is the result of inadvertent prompts (e.g., looking at the correct stimulus, a learner demonstrating a side bias) or noncriterion related stimuli. Highly skilled interventionists do not ascribe to mentalistic interpretations for changes in behavior (e.g., they are doing that because they are angry, they cannot discriminate). Ultimately, highly skilled interventionists conduct constant analyses of many different variables throughout the course of a session, and it is this analysis that guides them to make changes to maximize client progress.

Being highly skilled in analysis and readily identifying events that are responsible for behavior change can have numerous benefits with respect to autism interventionists. Not ascribing causal function to hypothetical constructs or intervening variables (e.g., the alignment of the planets, astrological signs, drives; Maccorquodale & Meehl, 1948) could avoid suggesting or, worse, implementing ineffective or harmful interventions (Zane et al., 2008). Accurate identification of events responsible for behavior change could also lead to more effective in the moment reinforcer assessment (Alcalay et al., 2019) in that the intervention could quickly identify if an event functions or does not function as a reinforcer. Also, accurate identification of events responsible for behavior change could ensure interventionists avoid inadvertent prompting and fade prompts effectively. That is, a highly skilled interventionist could identify if the desired response from the learner is occasioned by the desired stimulus control or some other undesired stimulus control and make intervention choices accordingly.

Objective

Along with being analytic, it is imperative that an interventionist is objective. Being objective means the interventionist is using objective behavioral data rather than relying on something unchanging such as a rule or something subjective such as a "feeling" or a "whim" when making clinical decisions. Such decisions might include, but are not limited to, what to target during a trial (e.g., interfering behavior, mastered target, target in acquisition), when to prompt, when to prompt fade, assessing potential reinforcers, or when to change activities. This data can come in the form of continuous (e.g., trial-by-trial; Cummings & Carr, 2009) or discontinuous data (e.g., estimation; Ferguson et al., 2020a). Furthermore, a highly skilled interventionist does not take unnecessary data, nor do they collect data that would interfere with teachable moments. It should be noted that clinical judgment (previously described) and objective data collection are not mutually exclusive; rather a highly skilled interventionist can use clinical judgment based upon in-the-moment analysis that is guided by data and other environmental variables.

Widely Competent

Highly skilled interventionists should be fluent and proficient in multiple teaching procedures (i.e., widely competent). It is not uncommon for training to only focus on one approach or procedure, which is exemplified by the research on staff training for autism intervention (Leaf et al., 2019). However, there are some notable examples in which training has focused on developing large classes or repertoires (e.g., Cheung et al., 2020; Weinkauf et al., 2011), which more closely aligns with the characteristics of a highly skilled interventionist. That is, a highly skilled interventionist demonstrates proficiency in multiple procedures (e.g., the teaching interaction procedure, video modeling, traditional functional analysis, practical functional assessment), teaching approaches (e.g., incidental teaching, discrete trial teaching, shaping), and professional and ethical skills (e.g., interactions with family and other professionals). Ultimately, there is no single procedure that will be appropriate and effective for all skills or all learners. As such, it is important for interventionists to be competent and fluent in a variety of evidence-based interventions and procedures. Ideally, this is measured through practice-based assessments as opposed to written or knowledge-based assessments (e.g., describing multiple procedures, answering questions about procedures). Furthermore, as previously noted, highly skilled interventionists modify and adapt these procedures and approaches as needed based on many different variables (e.g., the learners baseline levels of responding, prerequisite skills, the nature of the skill).

Conceptually Sound

In addition to fluency and competency in intervention skills, a highly skilled interventionist should have thorough conceptual knowledge of behavior analysis. This means a highly skilled interventionist not only implements procedures based upon the principles of ABA with high fidelity, but also demonstrates knowledge of the conceptual underpinnings of those principles. That is, a highly skilled interventionist understands why commonly implemented procedures and approaches to teaching such as shaping, differential reinforcement of an alternative behavior, criterion related prompting, functional communication training, behavioral skills training, and escape extinction result in the changes in behavior that is observed. A lack of this knowledge is demonstrated when an interventionist evaluates a procedure or principle as ineffective. As such, statements like "They can't discriminate" or "They don't have any reinforcers" are uncommon from a highly skilled interventionist. Instead, when a procedure is less effective or ineffective, a highly skilled interventionist assesses the variables related to the procedure and the learner and alters some aspect of the instructional context to facilitate improved learning. Relatedly, a highly skilled interventionist should have a thorough understanding of operant and respondent conditioning. Treating all behavior as operant behavior, which has been referred to as an *operant bigotry* (Leaf & McEachin, 2016), can lead to incorrect analysis of behavior, and, therefore, ineffective intervention. As such, having a thorough understanding of operant and respondent conditioning can help interventionists determine if a behavior is an operant or respondent, and make changes to the intervention as necessary.

Similar to a strong analytic repertoire, it is possible that a strong conceptual foundation may also make interventionists less susceptible to fad or pseudo-scientific treatments. There is a proliferation of fad and pseudo-scientific treatments within the ASD field, and it is likely that interventionists will contact their use or even be asked to implement one. If an interventionist does not have a strong conceptual foundation, they may not be able to identify the markers of such interventions (e.g., Green, 1996). Conversely, developing a strong conceptual foundation could increase the likelihood of the implementation of evidence-based procedures and insulate the interventionist from pseudoscientific and anti-scientific approaches.

Learner Progress as a Reinforcer

One key characteristic of a highly skilled interventionist is that learner progress and outcomes function as reinforcers. It is likely that highly skilled interventionists do not get into the field for the sole purpose of obtaining a paycheck. Although it is unlikely that many would continue work in the absence of a paycheck, for highly skilled interventionists, a paycheck should not be the sole source of reinforcement. Rather, a potent reinforcing event for highly skilled interventionists should be learner progress and outcomes. This progress can be large or small, and highly skilled interventionists notice these possibly nuanced changes and those changes often function as a reinforcer. A highly skilled interventionist can be observed sharing learner progress with team members, displaying favorable affect when observing a learner display a skill for the first time, and seeking out ways to accelerate learner progress—all of which are indicative of learner progress functioning as a reinforcer.

There are numerous possible benefits for learner progress and outcomes to function as a reinforcer for interventionists. Most notably, the learner's behavior is more likely to be a main source of control for the interventionist's behavior when learner progress functions as a reinforcer. It may also be the case that interventionist turnover will be lower when learner progress functions as a reinforcer as interventionists are more likely to contact reinforcement more frequently within the employment environment. Interventionists may be more receptive to training and suggested changes to programming and intervention when learner progress functions as a reinforcer as those changes may result in more learner progress and, as a result, more reinforcement for the interventionist.

Does Not Miss the Forest for the Trees

While individual goal targets are important, it is essential that an interventionist not fall into a trap in which decontextualized skills are the only focus of intervention, as opposed to understanding the bigger picture of intervention goals. A common example can be observed in the early teaching of nonverbal imitation. Imitation is meant to be a generalized repertoire that leads to more efficient and effective navigation of the environment, not simply imitating a handful of specific movements (e.g., a learner touching their head when the interventionist does the same). Instead, a highly skilled interventionist demonstrates an understanding of the small picture (e.g., touching your head) and big picture goals (e.g., a generalized imitative repertoire; Ala'i-Rosales et al., 2017). Ross (2016) illustrated this point well while discussing identifying if one is implementing effective ABA-based procedures when he said, "autism is not a disorder of not being able to touch your head." In situations such as this, where an interventionist is hyper-focused on the specific target in absence of allowing flexibility to advance a generalized imitative repertoire, the interventionist is not focusing on the underlying rationales for working on various skills, such as nonverbal imitation.

In another example, when describing the use of incidental teaching of socials skills, Ala'i-Rosales et al. (2017) stated, "the big picture is the development and maintenance of meaningful and fulfilling social relationships, the little picture is comprised of the momentary goals within a teaching interaction" (p. 181). The knowledge of big and little picture goals could be demonstrated within direct implementation and in the planning of a lesson. For example, the interventionist could be asked prior to a session what the big and little picture goals are for the client. The interventionist could demonstrate knowledge of big and little picture goals within the session by making in-the-moment decisions to stray away from a current learning objective to capitalize on another learning opportunity that may support one of the big picture goals.

Professional

It is imperative for an interventionist to be professional in all settings, with their clients, other professionals, and parents. Although, this may seem like an easy repertoire to develop and display, clinical experience shows that it may be difficult to master. First, an interventionist must understand and avoid any dual relationships and respect confidentiality of the client and their family (e.g., do not become Facebook friends with parents). More importantly, an interventionist must display what has been described as soft skills (e.g., Rohrer et al., 2021), perhaps more aptly described as displaying compassion (LeBlanc et al., 2020). These are skills which permit an interventionist to develop a therapeutic relationship with parents and other professionals, while maintaining professional boundaries. These skills include, but are not limited to, displaying clinical sensitivity with a parent, teacher, or other professional; knowing what questions to ask, when to ask questions, and when not to ask questions; knowing how to respond to questions from a teacher, parent, or a professional; knowing how much information to provide, what information to provide, and what information not to provide. Also, highly skilled interventionists attempt to understand the family's journey without being evaluative and understand that they cannot fully understand the family's journey because they have not walked in their shoes. Ultimately, highly skilled interventionists are approachable and warm, avoid being off-putting (e.g., using very technical jargon when parents do not have a thorough understanding of this jargon), and develop therapeutic relationships with their clients and their clients' caregivers.

Training Considerations

Development and training related to many of the repertoires outlined here may seem daunting. Many of these repertoires may take considerable time and effort to thoroughly develop, as they are more likely to be contingency shaped as opposed to rule governed. Fortunately, there are several effective training methods that have been evaluated within the literature as well as some examples of comprehensive training packages. Behavioral skills training (BST; Miltenberger, 2008) is perhaps the most widely researched and used training method within behavior analysis. BST is a multi-component training package that involves instruction, modeling, rehearsal, and feedback (Miltenberger, 2008). BST has been demonstrated to be effective to teach a variety of skills including, but not limited to, problem solving skills (Villante et al., 2021), implementation of token economies (Kirkpatrick et al., 2021), implementation of discrete trial teaching (Hillman et al., 2021), implementation of functional communication training (Clay et al., 2021), embedded teaching (Pisman & Luczynski, 2020), and culturally responsive behavior management procedures (Neely et al., 2020). As such, BST may be a fruitful training method when the goal is to develop the repertoires described within this chapter.

The Teaching Interaction Procedure (TIP; Phillips, 1968) also represents an effective training method. The TIP involves several core components: (1) identifying and labeling the targeted skill, (2) providing a meaningful rationale, (3) describing and demonstrating the target behavior, (4) role playing, and (5) providing feedback throughout the interaction (Cihon et al., 2017). As evident from this description, the TIP and BST share many common features; however, two primary features of the TIP distinguish it from BST. First, the TIP includes the provision of rationales. Second, the TIP includes a demonstration of the correct and incorrect way to engage in the targeted skill. The TIP has been demonstrated to be effective to teach implementation of token economies in a group home (Harchik et al., 1992), the Cool versus Not Cool procedure (Ferguson et al., 2020b), and the TIP (Green et al., 2020). While there has been considerably less research on the use of the TIP as a training method when compared to BST, the currently literature base is promising.

There have also been a few examples of comprehensive training packages within the literature. Weinkauf et al. (2011) provides perhaps the most relevant example with respect to the purpose of this chapter. Specifically, Weinkauf et al. evaluated the effectiveness of a comprehensive training package that included assessment, instructions, verbal descriptions, rationales, modeling, trainee practice, and feedback to evaluate and teach 125 interventionist skills. These skills were divided into ten domains (i.e., ethics, professionalism, rapport with supervisor, rapport with co-workers, rapport with child, functional communication training, program material management, learn-to-learn program implementation, domain specific skill acquisition, and session management). Each domain included more detailed skills. The results indicated that the training was effective in that all trainees demonstrated an increase in the correct implementation of the skills following training. Furthermore, the training was effective regardless of varying settings, children, programs, and trainers and over 120 skills reached the mastery criteria within a relatively short training time (i.e., 20–32.5 h).

Conclusion

This chapter, in combination with other sources (e.g., Ellis & Glenn, 1995; Leaf et al., 2016; Moore & Shook, 2001), is intended to outline *some* repertoires that should be considered while training individuals to provide ABA-based intervention for autistics/individuals diagnosed with ASD. It is not meant to be a definitive or comprehensive list. There has been and will likely continue to be debate over exactly what essential skills are required for an interventionist to be the most efficient and effective behavior change agent. This debate will likely continue until empirical research evaluating claims provide objective data on these essential, or nonessential, skills. One crucial step in developing this research might be identifying ways to measure each of these skills. Many of the skills discussed here involve complex interactions between the interventionist and another (e.g., supervisor, individual receiving intervention) which will make measurement difficult. However, quantifying these skills using objective measures will undoubtably be useful in identifying essential skill sets required for quality intervention. Our hope is that this chapter will assist in advancing our field's areas of focus for interventionist training, the development of objective and measurable definitions, and inspiring much needed research within this area. In that vein, Table 10.1 provides a list of these repertoires as well as examples and nonexamples that may be helpful when developing measurement systems for practice and research.

In addition to the development of objective measures of these essential skills, researchers could develop descriptive analyses of interventionists who would be considered highly skilled. These analyses could involve observing these interventionists for a certain period of time across a variety of contexts and clients and identifying and tracking their behavior and the behavior of the clients. This would be particularly helpful in evaluation of repertoires related to clinical judgement as it may provide insight into the possible variables responsible for the interventionist changing their behavior throughout a teaching episode. These descriptive analyses could also be useful in identifying the skills that are commonly displayed by interventionists that would be considered highly skilled, which could inform the development of task lists and training priorities. While these descriptive analyses could be informative, caution should be exhibited in generalizing skills displayed by interventionists in isolated contexts to all interventionists and contexts.

Research efforts should also evaluate the effects of the presence and absence of repertoires deemed essential on skill acquisition and outcomes. It is likely the case that the presence of the repertoires outlined within this chapter will lead to more rapid skill acquisition and, in turn, better outcomes. For instance, autism interventionists who are highly skilled in the analysis of behavior may be quicker at identifying when an approach is not working and make a change as a result. They may also be more accurate in identifying when a skill has been acquired and move on to target other necessary and important skills. Nevertheless, this is an empirical question that should be addressed with sound research. This research should make use of the benefits of single case research designs as well as large-scale randomized control trials.

Relatedly, future research should evaluate the effects of the presence and absence of repertoires deemed essential on client and consumer acceptability ratings of interventions. Behaviorally based autism intervention, and behavior analysis more broadly, has not gone without criticism (e.g., Breland & Breland, 1961; Sandoval-Norton & Shkedy, 2019). While the variables leading to these criticisms are likely vast and multifaceted, it would still be fruitful to examine the role of interventionist skill on client and consumer acceptability ratings of interventions. It may be the case that interventionists who implement less effective interventions, but do so in a more compassionate manner, are rated as more acceptable than interventionists who implement more effective interventions but do so in a less compassionate manner. This research would help identify what repertoires lead to more and less acceptability ratings and inform training programs to ensure repertoires related to client and consumer acceptability are also prioritized. Additional variables such as client assent and agency, and reciprocity in the teaching interaction itself, should be explored for their impact on the instructional outcomes and on the extent to which the intervention is seen as humane and compassionate.

Finally, future research could continue to examine the most effective and efficient training methods to develop these repertoires. While there has been extensive research on identifying effective and efficient training methods, much of this

Table 10.1 Examples and nonexamples of some repertoires of a highly skilled interventionist

Repertoire	Example(s)	Nonexample(s)
Understanding of Human Development and ASD	Knowledgeable of ASD and human development and the impact of ASD on development.	Not knowledgeable of ASD and human development and the impact of ASD on development.
Fun and engaging	Displays favorable affect most the time.	Displays neutral or unfavorable affect most of the time.
Receptive to feedback	Independently (i.e., without prompts) approaches supervisors for feedback on performance. Feedback results in an immediate change in behavior.	Feedback results in no change in behavior. Does not independently (i.e., without prompts) approach supervisors for feedback on performance.
Systematic	Develops a plan prior to each session. References plan throughout session. Can answer in the moment questions about next steps according to plan.	Begins teaching skills without a prior plan. Unsure what to do if the learner displays the target response prior to teaching.
Adaptive/flexible	Changes the plan when the learner is not performing successfully.	Continues to use the same plan even though the learner is not progressing.
Analytic	Identifies that the learner may be responding correctly because the interventionist is looking at the correct stimulus during a receptive label task.	Continues to place the correct stimulus in an array on the right side.
Objective	Collects and uses objective data to inform changes.	Does not collect or use objective data to inform changes. Collects data for accountability, but does not seem to use it for decision making.
Widely competent	Can fluently use DTT and incidental teaching to improve a learner's language.	Can only use DTT to teach expressive labels.
Conceptually sound	Identifies that they are not successful at shaping the target vocalization because the reinforcement used was not differential.	Says things like, "shaping doesn't work for this learner, DTT is the only thing that helps."
Learner progress functions as a reinforcer	Displays favorable affect when a learner displays the targeted skill. Seeks out others to discuss learner progress.	Learner progress does not appear to maintain the interventionist's behavior.
Doesn't miss forest for the trees	Can state the rationale for teaching skills like observational learning and imitation.	Continues to work on the same motor imitation target for months without changing the target. Is unable to describe big picture for goals.
Professional	Responds to other professionals, clients, and parents with compassion and empathy. Good ratings on rapport checklist, receives good parental reviews, connects easily and well with clients and families.	Responds to other professionals, clients, and parents with short responses, fails to connect with learners or families, is subject of consumer complaints, poor ratings on rapport checklist.

research is limited in scope (e.g., training one or a few skills in isolation; Leaf et al., 2019) with a few notable examples (e.g., Cheung et al., 2020; Weinkauf et al., 2011). Continued research will be necessary to develop and examine comprehensive training methods that develop all the essential skills required by autism interventionists. Additionally, research is needed in examining methods to develop the more complex repertoires outlined within this chapter as they will likely require an extensive number of learning opportunities and exemplars. Ultimately, interventionists are only as effective as our training methods are at developing the skills necessary to be effective. As such, the importance of continued research on effective training methods cannot be understated.

Ultimately, research related to effective training methods will always be necessary especially as we begin to examine the development of more and more complex repertoires of highly skilled interventionists. We hope this chapter will be useful in the identification, objective description, and measurement of some important repertoires to consider when training autism interventionists, as well as inspire research examining correlations between these repertoires and the outcomes and acceptability of behaviorally based autism intervention.

References

Ala'i-Rosales, S., Toussaint, K. A., & McGee, G. G. (2017). Incidental teaching: Happy progress. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder: Assessment, curricula, and intervention* (pp. 171–186). Springer International Publishing.

Alcalay, A., Ferguson, J. L., Cihon, J. H., Torres, N., Leaf, J. B., Leaf, R., McEachin, J., Schulze, K. A., & Rudrud, E. H. (2019). Comparing multiple stimulus preference assessments without replacement to in-the-moment reinforcer analysis on rate of responding. *Education and Training in Autism and Developmental Disabilities, 54*(1), 69–82.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Author.

Baer, D. M. (2001). A small matter of proof. In W. T. O'Nonohue, D. A. Henderson, S. C. Hayes, J. E. Fisher, & L. J. Hayes (Eds.), *A history of behavioral therapies: Founders' personal histories* (pp. 253–266). Context Press.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Baer, D. M., Wolf, M. M., & Risley, T. R. (1987). Some still-current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 20*(4), 313–327. https://doi.org/10.1901/jaba.1987.20-313

Baio, J., Wiggins, L., Christensen, D. L., Maenner, M. J., Daniels, J., Warren, Z., Kurzius-Spencer, M., Zahorodny, W., Rosenberg, C. R., White, T., Durkin, M. S., Imm, P., Nikolaou, L., Yeargin-Allsopp, M., Lee, L.-C., Harrington, R., Lopez, M., Fitzgerald, R. T., Hewitt, A., Pettygrove, S., Constantino, J. N., Vehorn, A., Shenouda, J., Hall-Lande, J., Braun, K. V. N., & Dowling, N. F. (2018). Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014. *MMWR Surveillance Summaries, 67*(6), 1–23. https://doi.org/10.15585/mmwr.ss6706a1

Behavior Analyst Certification Board. (2018). *RBT task list* (2nd ed.). Author.

Behavior Analyst Certification Board. (n.d.). *BACB certificant data*. Retrieved from https://www.bacb.com/BACB-certificant-data

Breland, K., & Breland, M. (1961). The misbehavior of organisms. *The American Psychologist, 16*(11), 681–684. https://doi.org/10.1037/h0040090

Carr, J. E., Nosik, M. R., & DeLeon, I. G. (2017). The registered behavior technician credential: A response to Leaf et al. (2017). *Behavior Analysis in Practice, 10*(2), 164–166. https://doi.org/10.1007/s40617-017-0172-1

Cheung, Y., Man Kit Cheung, A., Ho Yan Luk, E., Man Fung, Y., Mountjoy, T., Cihon, J. H., & Leaf, J. B. (2020). An evaluation of a comprehensive training package for interventionists providing behavioral intervention for children with autism spectrum disorder. *International Journal of Developmental Disabilities, 66*(5), 358–369. https://doi.org/10.1080/20473869.2020.1827208

Christensen, D. L., Baio, J., Van Naarden Braun, K., Bilder, D., Charles, J., Constantino, J. N., Daniels, J., Durkin, M. S., Fitzgerald, R. T., Kurzius-Spencer, M., Lee, L. C., Pettygrove, S., Robinson, C., Schulz, E., Wells, C., Wingate, M. S., Zahorodny, W., Yeargin-Allsopp, M., & Centers for Disease Control and Prevention. (2016). Prevalence and characteristics of autism spectrum disorder among children aged 8 years--Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. *MMWR Surveillance Summaries, 65*(3), 1–23. https://doi.org/10.15585/mmwr.ss6503a1

Cihon, J. H., Weinkauf, S. M., & Taubman, M. (2017). Using the teaching interaction procedure to teach social skills for individuals diagnosed with autism spectrum disorder. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder: Assessment, curricula, and intervention* (pp. 313–323). Springer International Publishing.

Clay, C. J., Schmitz, B. A., Balakrishnan, B., Hopfenblatt, J. P., Evans, A., & Kahng, S. (2021). Feasibility of virtual reality behavior skills training for preservice clinicians. *Journal of Applied Behavior Analysis, 54*(2), 547–565. https://doi.org/10.1002/jaba.809

Cummings, A. R., & Carr, J. E. (2009). Evaluating progress in behavioral programs for children with autism spectrum disorders via continuous and discontinuous measurement. *Journal of Applied Behavior Analysis, 42*(1), 57–71. https://doi.org/10.1901/jaba.2009.42-57

Davison, G. C. (1998). Being bolder with the Boulder model: The challenge of education and training in empirically supported treatments. *Journal of Consulting and Clinical Psychology, 66*(1), 163–167. https://doi.org/10.1037/0022-006x.66.1.163

Ellis, J., & Glenn, S. S. (1995). Behavior-analytic repertoires: Where will they come from and how can they be maintained?. *The Behavior Analyst, 18*, 285–292. https://doi.org/10.1007/BF03392715

Fabrizio, M. A. (2005, October). *Voting with their feet: The role of assent in behavior analytic intervention for children.* Paper presented at the Going Beyond Expectations: Unique Solutions in Autism Education

Conference. https://docplayer.net/22287468-Creating-for-children-the-aba-program-companion.html

Ferguson, J. L., Milne, C. M., Cihon, J. H., Dotson, A., Leaf, J. B., McEachin, J., & Leaf, R. (2020a). An evaluation of estimation data collection to trial-by trial data collection during discrete trial teaching. *Behavioral Interventions, 35*(1), 178–191. https://doi.org/10.1002/bin.1705

Ferguson, J. L., Milne, C. M., Cihon, J. H., Leaf, J. B., McEachin, J., & Leaf, R. (2020b). Using the teaching interaction procedure to train interventionists to implement the Cool versus Not Cool™ procedure. *Behavioral Interventions, 36*(1), 211–227. https://doi.org/10.1002/bin.1741

Goldiamond, I. (1974). Toward a constructional approach to social problems: Ethical and constitutional issues raised by applied behavior analysis. *Behavior, 2*(1), 1–84.

Green, G. (1996). Evaluating claims about treatments for autism. In C. Maurice, G. E. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism: A manual for parents and professionals* (pp. 15–28). Pro-Ed.

Green, D. R., Ferguson, J. L., Cihon, J. H., Torres, N., Leaf, R., McEachin, J., Rudrud, E., Schulze, K., & Leaf, J. B. (2020). The teaching interaction procedure as a staff training tool. *Behavior Analysis in Practice, 13*(2), 421–433. https://doi.org/10.1007/s40617-019-00357-2

Harchik, A. E., Sherman, J. A., Sheldon, J. B., & Strouse, M. C. (1992). Ongoing consultation as a method of improving performance of staff members in a group home. *Journal of Applied Behavior Analysis, 25*(3), 599–610. https://doi.org/10.1901/jaba.1992.25-599

Hillman, C. B., Lerman, D. C., & Kosel, M. L. (2021). Discrete-trial training performance of behavior interventionists with autism spectrum disorder: A systematic replication and extension. *Journal of Applied Behavior Analysis, 54*(1), 374–388. https://doi.org/10.1002/jaba.755

Kirkpatrick, M., Rehfeld, D. M., Akers, J. S., Rivera, G., & Sulak, T. N. (2021). Using behavioral skills training with preservice teachers in the university classroom. *Behavioral Interventions, 36*(1), 145–158. https://doi.org/10.1002/bin.1764

Leaf, R., & McEachin, J. (2016). The Lovaas model: Love it or hate it, but first understand it. In R. G. Romanczyk & J. McEachin (Eds.), *Comprehensive models of autism spectrum disorder treatment* (pp. 7–43). Springer.

Leaf, J. B., Oppenheim-Leaf, M. L., Leaf, R., Courtemanche, A. B., Taubman, M., McEachin, J., Sheldon, J. B., & Sherman, J. A. (2012). Observational effects on the preferences of children with autism. *Journal of Applied Behavior Analysis, 45*(3), 473–483. https://doi.org/10.1901/jaba.2012.45-473

Leaf, J. B., Leaf, R., McEachin, J., Taubman, M., Ala'i-Rosales, S., Ross, R. K., Smith, T., & Weiss, M. J. (2016). Applied behavior analysis is a science and, therefore, progressive. *Journal of Autism and Developmental Disorders, 46*(2), 720–731. https://doi.org/10.1007/s10803-015-2591-6

Leaf, J. B., Leaf, R., McEachin, J., Taubman, M., Smith, T., Harris, S. L., Freeman, B. J., Mountjoy, T., Parker, T., Streff, T., Volkmar, F. R., & Waks, A. (2017). Concerns about the registered behavior technician in relation to effective autism intervention. *Behavior Analysis in Practice, 10*(2), 154–163. https://doi.org/10.1007/s40617-016-0145-9

Leaf, J. B., Aljohani, W. A., Milne, C. M., Ferguson, J. L., Cihon, J. H., Oppenheim-Leaf, M. L., McEachin, J., & Leaf, R. (2019). Training behavior change agents and parents to implement discrete trial teaching: A literature review. *Review Journal of Autism and Developmental Disorders, 6*(1), 26–39. https://doi.org/10.1007/s40489-018-0152-6

Leaf, J. B., Leaf, R., McEachin, J., Bondy, A., Cihon, J. H., Detrich, R., Eshleman, J., Ferguson, J. L., Foxx, R. M., Freeman, B. J., Gerhardt, P., Glenn, S. S., Miller, M., Milne, C. M., Mountjoy, T., Parker, T., Pritchard, J., Ross, R. K., Saunders, M. S., & Streff, T. (2021). The importance of professional discourse for the continual advancement of practice standards: The RBT® as a case in point. *Journal of Autism and Developmental Disorders, 51*(5), 1789–1801. https://doi.org/10.1007/s10803-020-04631-z

Leblanc, L. A., Taylor, B. A., & Marchese, N. V. (2020). The training experiences of behavior analysts: Compassionate care and therapeutic relationships with caregivers. *Behavior Analysis in Practice, 13*(2), 387–393. https://doi.org/10.1007/s40617-019-00368-z

Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*(1), 3–9. https://doi.org/10.1037//0022-006x.55.1.3

Maccorquodale, K., & Meehl, P. E. (1948). On a distinction between hypothetical constructs and intervening variables. *Psychological Review, 55*(2), 95–107. https://doi.org/10.1037/h0056029

McGee, G. G., & Morrier, M. J. (2005). *Preparation of autism specialists* (Vol. 7). Wiley. https://doi.org/10.1002/9780470939352.ch19

McLaughlin, D. M., & Carr, E. G. (2005). Quality of rapport as a setting event for problem behavior: Assessment and intervention. *Journal of Positive Behavior Interventions, 7*(2), 68–91. https://doi.org/10.1177/10983007050070020401

Miltenberger, R. G. (2008). Behavioral skills training procedures. In R. G. Miltenberger (Ed.), *Behavior modification: Principles and procedures* (pp. 251–272). Wadsworth.

Moore, J., & Shook, G. L. (2001). Certification, accreditation, and quality control in behavior analysis. *The Behavior Analyst, 24*(1), 45–55. https://doi.org/10.1007/BF03392018

Nathan, P. E. (2000). The Boulder model: A dream deferred—Or lost? *American Psychologist, 55*(2), 250–252. https://doi.org/10.1037/0003-066x.55.2.250

Neely, L., Gann, C., Castro-Villarreal, F., & Villarreal, V. (2020). Preliminary findings of culturally responsive consultation with educators. *Behavior Analysis in Practice, 13*(1), 270–281. https://doi.org/10.1007/s40617-019-00393-y

Phillips, E. L. (1968). Achievement place: Token reinforcement procedures in a home-style rehabilitation setting for "pre-delinquent" boys. *Journal of Applied Behavior Analysis, 1*(3), 213–223. https://doi.org/10.1901/jaba.1968.1-213

Pisman, M. D., & Luczynski, K. C. (2020). Caregivers can implement play-based instruction without disrupting child preference. *Journal of Applied Behavior Analysis, 53*(3), 1702–1725. https://doi.org/10.1002/jaba.705

Rohrer, J. L., Marshall, K. B., Suzio, C., & Weiss, M. J. (2021). Soft skills: The case for compassionate approaches or how behavior analysis keeps finding its heart. *Behavior Analysis in Practice, 14*, 1135–1143. https://doi.org/10.1007/s40617-021-00563-x

Ross, R. K. (2016, April 22). *Are you doing ABA? Behavioral indicators of the effective implementation of ABA* [Conference Session]. 1st Annual Center for the Advancement Behavior Analysis Autism conference.

Sandoval-Norton, A. H., & Shkedy, G. (2019). How much compliance is too much compliance: Is long-term ABA therapy abuse? *Cogent Psychology, 6*(1), 1641258. https://doi.org/10.1080/23311908.2019.1641258

Shireman, M. L., Lerman, D. C., & Hillman, C. B. (2016). Teaching social play skills to adults and children with autism as an approach to building rapport. *Journal of Applied Behavior Analysis, 49*(3), 512–531. https://doi.org/10.1002/jaba.299

Smith, T., Groen, A. D., & Wynn, J. W. (2000). Randomized trial of intensive early intervention for children with pervasive developmental disorder. *American Journal of Mental Retardation: AJMR, 105*(4), 269–285. https://doi.org/10.1352/0895-8017(2000)105<0269:RTOIEI>2.0.CO;2

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis, 21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Villante, N. K., Lerman, D. C., Som, S., & Hunt, J. C. (2021). Teaching adults with developmental disabilities to problem solve using electronic flowcharts in a simulated vocational setting. *Journal of Applied Behavior Analysis, 54*(3), 1199–1219. https://doi.org/10.1002/jaba.786

Weinkauf, S. M., Zeug, N. M., Anderson, C. T., & Ala'i-Rosales, S. (2011). Evaluating the effectiveness of a comprehensive staff training package for behavioral interventions for children with autism. *Research in Autism Spectrum Disorders, 5*(2), 864–871. https://doi.org/10.1016/j.rasd.2010.10.001

Zane, T., Davis, C., & Rosswurm, M. (2008). The cost of fad treatments in autism. *Journal of Early and Intensive Behavior Intervention, 5*(2), 44–51. https://doi.org/10.1037/h0100418

Social Skills and Applied Behavior Analysis

11

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Introduction

Social skills pose difficulty for practitioners working with autistics/individuals with autism. Often, they are an area in which progress is difficult to achieve, outcomes are hard to define, and instructional methods never quite seem comprehensive or effective enough. In recent years, more discussion has also taken place about the nature of social skills instruction itself. In other words, should we be targeting these skills as much as we do? Is this a deficit-based framework? Should we be defining these goals differently? Indeed, a seismic shift in the understanding of these skills is underway.

In this chapter, we take a pragmatic approach. We focus on the best interests of the client. Specifically, we view social skills as appropriate targets when addressing them helps the individual achieve their self-determined goals, when quality of life improves as a result of instruction, and when assent is continually solicited for the instructional experience. It is imperative to view social skills through a lens of humane treatment and compassionate care, and to implement social skills instruction in a culturally responsive, individualized manner that reflects the vision of and for the autistic/individual with autism.

We begin the chapter with a discussion of the conceptual underpinnings of social skills intervention. This provides a framework for understanding social skills and for prioritizing their development. It also underscores that individualization and social validity remain the heart of behavior analytic intervention. As we move into implementation, we focus on the processes of assessment and goal development. In this section, the importance of individualization is emphasized, especially as it relates to identifying outcomes that matter.

We review the impact of age on the appropriateness of goals, identifying central, pivotal issues in each age range. Special attention is given to the initial social connection experiences of infants and toddlers, particularly as it sets the foundation for social and emotional development. The unique challenges of adults are also reviewed, with social skills focusing on increasing outcomes for socialization, employment, and independent living.

Finally, we review interventions commonly used, including those with less robust data and those for which ample evidence exists. A wide variety of effective interventions are available, and can be used to build complex skills such as social comprehension and understanding hidden social rules. It is our hope that this chapter helps articulate an approach to social skills instruction that empowers clients, stakeholders, and professionals to identify relevant goals, to focus on meaningful outcomes, and to enhance quality of life.

Conceptual Underpinnings

The diagnostic criteria for autism spectrum disorder are characterized by "deficits" in "social" communication and interaction as well as restrictive, repetitive repertoires of behavior. This combination of symptoms when taken as a whole suggests a current relevant behavioral repertoire with limited social reinforcers, with the primary source of reinforcement coming from the physical environment. However, in consideration of the individual as a whole, a more appropriate question may be to ask, "What set of skills is missing for the individual to access additional reinforcers?" Humans, as well as other organisms, have developed social repertoires to maximize their ability to establish contingencies to maintain social behaviors. But what are these "social" behaviors? How are they shaped? What potentiates a contingency in which one reinforcer has value over another?

While the specific etiology of autism spectrum disorder may not be elucidated, identification of observable behaviors occurring or not occurring can be identified. Some further examples of such behaviors can also be found in the diagnostic criteria in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) including

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of

interests, emotions, or affect; to failure to initiate or respond to social interactions.

2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

However, these behaviors all suggest a range of normal to abnormal, some level of "shared" interests, attention to another's behavior, responding to another individual in the form of "verbal" and "non-verbal" communication. A common theme throughout these core areas of deficit is the presence and interaction between both a speaker and listener.

What is a social skill? Inherent in the term "social" suggests an interaction between two organisms. Skinner (1957) initially defined verbal behavior as the interaction between a speaker and listener in which the listener reinforces the behavior of the speaker. Examples of "social skills" include looking at, orienting toward others as natural shaping procedures are used from early on in life by a speaker, to specifically shape the behavior of the listener. He later modified this definition to include the listener being specifically shaped by the speaker. Therefore, a more apt behavioral description of a deficient repertoire in individuals with autism is a limited repertoire of verbal behavior.

A range of component behaviors are required to attend to social stimuli: psychomotor behavior (e.g., joint attention, social referencing, eye gaze, and turning head toward a stimulus), interaction with social stimuli, simple cognitive behaviors (i.e., associations, discriminations, verbal behavior), and application of rules to social stimuli in complex cognitive behaviors (i.e., concepts, principles, strategies; see Fig. 11.1). Motor behaviors must not only be present in the repertoire, but must be consistently and fluently demonstrated by the individual prior to more complex skills being added

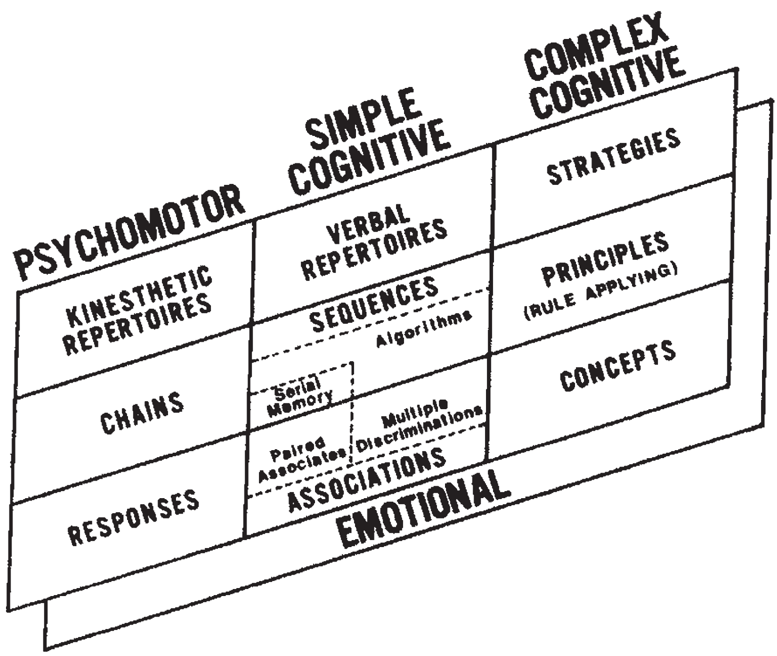

Fig. 11.1 Types of learning (Tiemann & Markle, 1990)

into a social skills program. Once the prerequisite psychomotor behaviors are present, more complex sequences of simple cognitive (i.e., associations, discriminations, sequences, verbal repertoires) and ultimately complex cognitive (i.e., concepts, principles, and strategies) learning can be acquired (Tiemann & Markle, 1990). Underlying all learning processes is "emotional learning" (Tiemann & Markle, 1990, p. 1). Emotional learning represents a combination of responses, overt or covert, that occur during the learning process. "We cannot see into inner feelings so we must watch for actions we can observe. And even then we can only assume, or infer, that an observable response is an indicator of a particular emotion" (Tiemann & Markle, 1990, p. 2). Therefore, it is incumbent upon the instructor to analyze contingencies related to approach or avoidance of the instructional program. In Fig. 11.1, "Emotional" is underscored throughout the entire learning taxonomy as any type of learning may occasion emotional learning.

An additional component to elucidating social behavior is an individual/social contingency analysis. Weingarten and Mechner (1966) make the distinction between an independent and a dependent contingency, the latter of which describes an arrangement of variables in a social context. An independent contingency is the arrangement of variables by the experimenter with a single participant. A dependent contingency includes the components of an independent contingency as well as the interaction between two participants. This interaction is conceptualized as the dependency of one organism upon another to reach a critical consequence (i.e., the consequence that leads to reinforcement). For example, controlling relations in an independent contingency include variables such as stimuli and schedules of reinforcement that are arranged to produce the presence or absence of a response. Dependent contingencies are dependent on the interaction between two individuals, in which one individual "alters the stimulus conditions" of another either in competition or cooperation (Weingarten & Mechner, 1966, p. 454).

Holth et al. (2009) evaluated the operant process of conditioned social reinforcers though pairing and operant discrimination (S^D) procedures for joint attention. A previously neutral stimulus was either established as an S^D for a response that produced a positive reinforcer or paired with a positive reinforcer in a 1-s delay classical conditioning procedure. Results indicated an S^D procedure in which responses were contingent produced more responses than simply pairing. Pelaez et al. (2012) also used operant discrimination procedures to establish mothers' facial expressions as discriminative stimuli to signal positive reinforcement or aversive stimulation.

"We need separate but interlocking accounts of the behaviors of both speaker and listener if our explanation of verbal behavior is to be complete. In explaining the behavior of the speaker, we assume a listener who will reinforce his behavior in certain ways. In accounting for the behavior of the listener we assume a speaker whose behavior bears certain relation to environmental conditions" (Skinner, 1957, p. 34). It is this interaction between the speaker and listener in which the autistic learner as speaker specifically reinforces the listener in relation to their current environment. Within the context of social stimuli, the reinforcement may be in the form of negative reinforcement if contingencies are not arranged to include positive social interactions. But where do we start teaching?

As stated in the DSM-5 some characteristics of autism are "abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication" (American Psychiatric Association, 2013, p. 50). Replacing "abnormalities" with repertoires to be constructed (Goldiamond, 1974) represents not only a more accurate description of behavior but also considers the individual as a whole person with abilities, instead of a collection of symptoms. Identification of the current relevant repertoires to build an educational program focuses on the individual learner's strengths.

Assessment and Goal Development

Assessment is a critical component of evaluating an individual's current level of social behavior, identifying social skill strengths, and identifying social skill deficits. Several assessments and curricula have been developed in order to help practitioners and researchers in the field of ABA and autism treatment measure, track progress, and select social skills goals. Social skills assessments currently available include norm-referenced assessments (i.e., assessments that compare skills for autistic individuals to typically developing individuals) and environmentally based assessments (i.e., assessments that identify inconsistencies between skills necessary in certain social situations and the current behavior of the individual; Freeman & Cronin, 2017). Additionally, several social skills curricula have been developed and created that outline scope and sequence of social skills that may be beneficial to teach learners with ASD and may also include assessment components to help practitioners identify skills to teach.

Common Norm-Referenced Social Skills Assessments

The Social Responsiveness Scale (SRS-2; Costantino & Gruber, 2012) is an objective social skills assessment comprised of 65 questions and can be used for individuals ages 2.5 years through adulthood. The SRS-2 uses a 4-point Likert scale to measure social skills and autism severity aligning with the DSM-5 (American Psychiatric Association, 2013). The SRS-2 measures social behavior across five domains: (a) social awareness, (b) social cognition, (c) social communication, (d) social motivation, and (e) restricted interests and repetitive behavior.

The Social Skills Improvement System (SSiS; Gresham & Elliott, 2008) is a norm-referenced assessment that can be used to assess social behavior for individuals ages 3–18 years. The SSiS is unique in that it can be filled out by a teacher, parent/caregiver, or the autistic individual themselves. The SSiS uses a 4-point Likert scale for the responder to score each item based on the frequency in which the social skill is used. The SSiS breaks down the skills measured in the assessment into seven social skill subdomains (i.e., communication, cooperation, assertion, responsibility, empathy, engagement, self-control). Additionally, the SSiS allows the responder to rate how important each item on the assessment is for the learner to engage in in order to help guide intervention planning. For example, if an autistic individual is filling out the SSiS, they would be able to rate each skill on the assessment as critical, important, or unimportant for them to engage in.

The Vineland-3 (Sparrow et al., 2016) is another norm-referenced assessment that can be useful to assess social behavior for autistic children. The Vineland-3 measures overall adaptive behavior through three subscales: (a) communication, (b) daily living skills, and (c) socialization (Sparrow et al., 2016). Subdomains of communication and socialization can be particularly helpful to measure social-communication strengths and deficits for autistic individuals. Additionally, this assessment can be used for ages 0–90 so it can be used as an ongoing tool to assess social behavior across the lifespan.

Environmentally Based Social Skills Assessments

The Treatment and Research for Autism Spectrum Disorders (TRIAD) developed the TRIAD Social Skills Assessment (TSSA) as a tool to help guide practitioners evaluate social profiles for children with ASD (Stone et al., 2010). The TSSA is for children ages 6–12 and assesses the knowledge and skills of children across three skill areas (i.e., cognitive, behavioral, and affective). Additionally, information from parent report, teacher report, observation, and direct child interaction are combined to complete the social skills assessment (Stone et al., 2010).

The Verbal Behavior Milestones Assessment and Placement Program (VB-MAPP) is another environmentally based assessment that can be useful to identify social skills strengths and deficits (Sundberg, 2008). The VB-MAPP uses B. F.

Skinner's analysis of verbal behavior (Skinner, 1957) to provide an assessment that encompasses important learning, language skills, play skills, and social skills for children with ASD.

The Assessment of Basic Language and Learning Skills-Revised (ABBLS-R) is another assessment based on Skinner's analysis of verbal behavior that can be beneficial to identify social skills to target (Partington, 2006). The ABBLS-R is comprised of 25 skill domains including language and social interaction skills that are arranged from simpler to more complex skills (Partington, 2006).

Additional social skills curriculums and assessments that may be helpful for practitioners to assess individual learner's social behavior are the Pretend Play and Language Assessment and Curriculum (PPLAC; Champlin & Schissler, 2017), Skillstreaming (McGinnis, 2012), the Program for the Education and Enrichment of Relational Skills (PEERS®; Laugeson, 2013), Crafting Connections (Taubman et al., 2011), and Socially Savvy (Almeida & Ellis, 2014). Depending on the age and skill set of the child one or more of these assessments and curriculums is likely to be beneficial to help assess social behavior. It is important to remember that just one assessment is unlikely to cover all the social skills a child may need to be successful in their environment and social validity, client preference, and observation of the child in their environment should all be taken into account in addition to the information gathered from assessment tools.

Selecting Goals

Goals for intervention should be based on maximizing reinforcement and minimizing punishment for the client in both the short term and the long term. Within that overarching purpose, particular reasons for selecting goals may include that they are prerequisites for other useful skills, will increase access to valuable environments, will increase the likelihood others will interact with them positively, are behavioral cusps (a new behavior that allows for access to new reinforcers), or are pivotal behaviors (ones that produce changes in other behaviors without further training; Cooper et al., 2019). When there are many goals that could be targeted, they can be prioritized based on the following nine criteria: (a) not teaching it could be dangerous (i.e., self-preservation), (b). it's a skill they'll use frequently, (c). the skill deficit is long-standing, (d) learning it will result in higher rates of reinforcement for the individual, (e) the skill is critical for future goals, (f) it will result in more positive interactions with others, (g) it will produce reinforcement for others in the client's life, (h). success is likely, and (i) the costs of selecting this goal have been considered (Cooper et al., 2019).

Choosing goals in the domain of social skills requires particularly thoughtful consideration. The individual's preferences and the social community in which the individual will interact need careful attention when beginning social skill instruction. The neurodiversity movement has made it clear that many autistic adults not only do not consider many social goals such as eye contact valid, and instead consider them harmful. Teaching social skills can be seen as a way to force the autistic person to conform instead of a way to help them meet their own goals (Leadbitter et al., 2021). In light of this, it's critical to pay particular attention to the client's participation in goal selection and assent to social skill instruction.

Schwartz and Baer (1991) identified a continuum of relevant stakeholders in a behavioral intervention: the direct consumer or client, indirect consumers such as parents or teachers, members of the immediate community (i.e., people who interact with the client on a regular basis), and members of the extended community (i.e., people in the same community who aren't likely to interact with the client regularly). These stakeholders can be placed in concentric circles (like a target) with the direct consumer in the center. Behavior analysts must act in the best interest of that direct consumer at all times, promote their self-determination, and involve them in goal selection to the extent possible (Behavior Analyst Certification Board, 2020). Participation in goal selection may take various forms depending on the age and skills of the client, but should not be ignored. For a very young child or an individual with extremely limited communication, the clinician and guardians may choose goals that involve the individual's demonstrated strengths and interests and quickly modify goals if they don't demonstrate assent to instruction (see the following paragraph for discussion of assent). As the individual ages and has more communication skills, they can be increasingly involved in identifying goals that are important to them, from choosing games to learn to play with peers, to identifying people they'd like to be friends with, to identifying other important outcomes (such as getting a job) that involve mastery of social skills.

Assent

Assent is the agreement to participate by someone who is not able to give legal consent, such as a young child. Assent is sometimes measured by response to a question ("Would you like to join the social skills group today?") or by measurement of assent behaviors (e.g., active participation, smiling) and assent-withdrawal behaviors (e.g., crying, leaving the area). A more thorough approach to assent is the use of a concurrent chains procedure in which the individual makes a choice between multiple conditions. In a concurrent chains procedure, each of several conditions (such as different instructional targets, teaching procedures or a teaching condition and a break condition) is correlated with a stimulus such as a colored square or button. The client selects one stimulus and participates in that condition for a short period of time before having another opportunity to select a stimulus. Through this procedure, you not only assure the client is making an "informed decision" ("informed" because they gain experience with each of the choices) and allow them to choose between teaching procedures, but you gather data over time on their preference. See Morris et al. (2021) and Hanley (2010) for more details.

Also critical in choosing social goals is identifying and assessing the community in which the social skills will be used. There are whole books in which "social skills" are mostly related to social interactions with adults, such as "asking permission" and "accepting no." While adults are a part of an individual's social community, and are likely to be vocal in identifying potential goals, a client's peer group or potential peer group (typically similar age peers contacted during everyday life such as at school, the community, or work) must be considered. The types of social behaviors that are reinforced in a group of preschoolers are very different from the types of social behaviors that are reinforced in a group of middle school boys. In neither group, however, is starting an interaction by saying, "Hi. My name is Joe. It's nice to meet you." or "May I please play with you?" a social skill that is likely to be very successful. To avoid mistakes like these, identify the people with whom the client will be using the social skills and assess the types of interactions that are common (imaginative play? Active play? Chatting? Sending text messages?) and what kind of behaviors are reinforced (Physical interactions like high fives? Active listening and discussion of feelings? Gossip? Slang?) before selecting social skills to teach.

Age-Related Priorities

Infants and Toddlers

While the average age of diagnosis is 5 years old (or 3.5 years for children diagnosed under the age of 10 years; van't Hof et al., 2021), there are many signs of autism that appear earlier than 18 months (Tanner & Dounavi, 2021). Motor delays and delays in eye tracking are evident at 6–7 months. Delays in joint attention, orienting to name, performance on a head tilt test can all be seen before 12 months. Limited smiling, fewer gestures, less coordinated communication, increased stereotypy, and less social initiation can all be seen before 18 months of age. In the future, diagnosis could potentially occur at younger ages, leading to an earlier start for social skill interventions for infants and toddlers.

Generally, research on providing intervention in infants and toddlers (pre-diagnosis) is in its early stages but is promising. There are limited randomized controlled trials, with only three conducted with children up to 18 months of age, with significant risks of bias in two of the three (Bradshaw et al., 2015). However, there is a fair number of single case designs showing that behavioral interventions can improve early social skills in young children. A review of the literature identified four important skills developed in infants that are essential for development of further social skills: vocalizations, eye gaze, joint attention, and social referencing (Neimy et al., 2017).

Vocalization or babbling is a building block for future communication, and its absence may predict a later diagnosis of autism. One promising intervention used to increase vocalizations is contingent imitation, or immediately repeating any sounds the infant makes. Pelaez et al. (2018) studied three infants, ages 3, 8, and 14 months and compared 2-min sessions in which the experimenter either imitated the infant's vocalizations or made sounds unrelated to the child's babbling. All three infants babbled more in the contingent imitation condition—approximately twice as much as the control condition.

Eye gaze is a foundational social skill; when development of eye gaze does not emerge as expected, it often leads to early diagnosis of autism (Neimy et al., 2017). Eye gaze is foundational in the sense that learning other social skills all require attending to social stimuli—other people. For example, a baby can't learn about facial cues without looking at people's faces. Specifically, eye gaze is a prerequisite for the following two skills, joint attention, and social referencing (Pelaez & Monlux, 2018). An intervention that has been demonstrated to be effective for increasing eye gaze in infants is called the synchronized reinforcement procedure. In this procedure, an adult waits until the infant looks toward their face. Then the adult reinforces the eye gaze with smiling, cooing, and/or touching the infant continuously as long as the infant maintains the eye gaze (e.g., Peláez-Nogueras et al., 1996).

Joint attention, which Neimy et al. (2017) defined as, "one's ability to use eye contact and gestures to both initiate and respond to bids of sharing objects with other individuals socially" (p. 13–14) is another early social skill that develops during infancy. While deficits in joint attention are observed in infants as early as 12 months of age (Franchini et al., 2019), there is relatively little research on joint attention interventions for infants. A number of studies with preschool-aged children could be extended to a younger age group. Holth et al. (2009) note that while it is possible to teach behaviors that look like joint attention (pointing to an item as a request, for example), the core deficit seems to be that social interactions don't function as conditioned reinforcers, and because of that, attempts to teach joint attention behaviors often don't maintain under natural conditions. Holth and colleagues studied two different procedures to condition social interactions as reinforcers. The first condition was a traditional stimulus-stimulus pairing procedure (in which an originally neutral stimulus was followed immediately by presentation of an unconditioned reinforcer). The second condition was an operant discrimination procedure in which the neutral stimulus was the cue that if the child engages in a particular behavior, reinforcement would follow. They found that the operant discrimination procedure was more effective in conditioning new stimuli as reinforcers, with five out of seven children showing clear differences between the two conditions. When this procedure was incorporated into an instructional program to teach joint attention skills, Isaksen and Holth et al. (2009) found that children with autism made meaningful gains in joint attention skills that were maintained for a month after treatment across a variety of settings.

Social referencing occurs when a child, upon encountering a novel stimulus, looks to a caregiver and responds to the novel stimulus according to the caregiver's expression. Pelaez et al. (2012) demonstrate the effectiveness of discrimination training, for teaching social referencing to 4- to 5-month-old infants. A novel item would be presented, and if the infant reached for it, one of two consequences would follow. If the mother had a joyful expression on her face, reaching for the item resulted in pleasant music and lights. If the mother had a scared expression on her face, however, reaching for the item resulted in a blue light and an unpleasant (but safe) sound like that of a blender. All infants quickly learned social referencing; that is, to reach for items when their mother looks happy, but not when she looks scared.

The home is the most common setting for early intensive behavioral intervention. In-home behavioral intervention is often provided intensively (e.g., 20 h/week or more) provided in a 1:1 manner by a behavior technician overseen by a Board Certified Behavior Analyst (BCBA). There are many benefits to a home-based program. For young infants and toddlers, the home is the natural environment in which social interactions take place. Thus, intervention within the home setting is more likely to be effective and efficient. Similarly, for a young child, parents and siblings are the primary people with whom social interactions will take place, and by providing the instruction in the home, it may be easier to incorporate them directly into the social skills instruction and teach them how to facilitate successful social interactions themselves. Finally, the home may be an ideal environment in which to begin instruction to the extent it can provide a quiet environment with limited distractions.

Preschool Age

Early intensive behavioral intervention often begins during the preschool years, following a diagnosis of autism. While social skills are included in some common curricula for early intervention (e.g., Leaf & McEachin, 1999; Sundberg, 2008), research suggests there is still a need for increased social skill intervention during the preschool years. Matson et al. (2007) noted that in research, social skill instruction often started with school-aged children (ages 6–9), despite the fact that such skills are typically developed at an earlier age.

Several factors may contribute to the later introduction of social skills. First, many early intervention programs are run in the home. While this is a natural environment for young learners and provides many benefits, one of the drawbacks to in-home programs is a lack of peers—critical for successful social skill instruction. In addition, most early intervention programs are run in a 1:1 staffing model. A 1:1 model is considered standard in EIBI and is often required by insurance funding sources. Additional challenges that limit social skills instruction in the preschool years include that other skills may be seen as prerequisites for social skills and that practitioners might not have adequate training in teaching early social skills. In addition, important social skills that should be taught during the preschool years include observational learning (DeQuinzio et al., 2018; Jahr et al., 2000; Townley-Cochran et al., 2015), initiating and responding to peers, play skills (Barton, 2010), and conditioning peer interactions as reinforcers (Holth et al., 2009).

Some quintessential social skills that emerge in infanthood and toddlerhood may need to be targeted during the preschool years if they are still not evident. Joint attention (Isaksen & Holth, 2009; Monlux et al., 2019) and social referencing (Monlux et al., 2019; Weisberg & Jones, 2019) are related to core deficits of autism, and because behavioral intervention may not have been provided previously, both targets should be considered a priority during the preschool years (see the previous section). Observational learning, defined as “the observation of others coming in contact with consequences and the subsequent acquisition of new responses or conditioning of reinforcers as a result of these observations” (Townley-Cochran et al., 2015, p. 263), is particularly important in social skills, as many social skills and norms are learned by observing others, and it may be impractical or unrealistic to directly teach all social skills a person will need throughout their life. For example, a child joining a game that doesn’t have set rules, such as in an imaginary play context, may be more successful if they first observe and then engage in the same types of interactions as the other children. Some guidelines for teaching observational learning include teaching children to attend to peers for sustained periods of time, to engage in generalized imitation of peers actions, and to discriminate between presence and absence of reinforcement of peers’ behaviors (Taylor & DeQuinzio, 2012). Direct instruction of observational learning of social skills might involve opportunities to watch one peer engaging in a social interaction and a second peer reinforcing it (e.g., "Oh, cool!") or ignoring it. The student then could be prompted to imitate the interaction if it was reinforced and not if it was ignored.

School Age

When children start attending school the differences between the learner with ASD and their typical peers may become more noticeable. The school environment presents behavioral rules that the student with ASD may have difficulty following and unclear social rules that they have not yet learned. Several key areas of focus help to increase the success of the learner and ease their adaptation to the school environment.

Communication deficits complicate comprehension of the social context. A young child may not understand what others are communicating, may be nonvocal, or may not have developed an effective method to communicate. Additionally, a learner may be capable of vocal language but be disinterested in his or her peers, have had negative experiences with peers, or may not know how to respond to his or her peers. Initiations for social interaction may be absent, unsuccessful, unclear, or inappropriate. For instance, instead of saying, "Hi" or joining in on play, a learner may push a peer or fail to respond when a peer asks him or her to join them, move out of the way, or let them have a turn. Alternatively, a learner with ASD may fail to respond to a peer during an introduction. This lack of responding and initiating may negatively impact any future social interactions with peers, as peers may feel rejected or surmise that the child with ASD is uninterested in social contact. Teachers can work to support the individual with autism in connecting with peers in preferred ways and in preferred activities, and can help peers to understand the preferences of the learners with autism and to persist in their efforts.

Sometimes learners will engage in behaviors that make a peer uncomfortable or confused including standing too close, not facing them while they are speaking to the peer, speaking too loudly or too softly, abruptly walking away from an interaction, or seeming disinterested in them (Kennedy & Adolphs, 2014; Myles, 2003). These are behaviors that have been reinforced by the broader social community, and which the learner may not be aware of. In an ideal world, there would also be more expansive definitions of what are acceptable ways to interact, and there would be an understanding that there are differences in what people prefer in terms of social experience and in how people express interests or pursue interaction. Many improvements are being made in the world's understanding of autistic experience, and more tolerance will likely be prevalent in schools in the coming years (Watkins et al., 2015, 2019). However, at present, most children with autism will be expected to understand the more generically applied classroom social expectations.

It is also possible that the learner with ASD has difficulty understanding complex language or unfamiliar references (Myles, 2003; Baker, 2008). This could lead to confusion on the part of both peers and students with ASD and negatively impact future social interactions. For instance, a learner with ASD may hear students talking about games that they no longer play such as Minecraft. The learner with ASD may hone in on the word Minecraft and get excited because peers are talking about the game he loves. He approaches and starts talking about all of the items that he has mined, not realizing that the other students mentioned Minecraft as a game they no longer play, and the students move away from him. Here, our learner picked up on familiar wording and joined a social situation, but his interaction was unsuccessful because he didn't understand the context in which the peers were talking. Instruction can assist the learner by increasing familiarity with common topics and references, and can assist them in successfully joining activities and conversations.

Another area of responding that must be addressed in communication is fluency (Kubina Jr & Yurich, 2009; Weiss et al., 2010). A learner with ASD may know how to and want to initiate or respond to a peer, but take too long to do so. When people don't respond quickly enough, the communication partner may interpret this as a lack of interest or be disinclined to try again, as their effort was not met with success. Social skills interventions may target response latency, duration of responding, or rate of responding by having a learner watch videos of themselves or others responding too slowly, talking too long, speaking too slowly, or too quickly to peers during social interactions. By tracking his or her behavior, the learner can come to understand how their behavior impacts the person they are trying to interact with. They can practice shortening the time between their response and a question or comment posed to them, or speaking for shorter periods, or slowing down or quickening her language to improve the social interaction.

Another area that is often specific to learners with ASD is difficulty in taking the perspective of another person (Howlin et al., 1999; Ozonoff & Miller, 1995; Peters & Thompson, 2018). This may be demonstrated as not being able to "read the room" and engage in behavior that is unlikely to result in reinforcement by not matching what their peers are doing and saying. For instance, a group of peers may be talking about a specific video game and a learner with ASD may join the conversation and persist in talking about a genealogy website, not noticing that he has: (a) interrupted the conversation, (b) is talking about a topic that he has not introduced properly, and (c) is talking about a different topic than the rest of the peers. The student with ASD's interests may be incompatible with their peers and they may not notice that or understand why no one is interested in what they are talking about. To have a successful social interaction, one must be able to understand how the other person feels or what they are interested in talking or learning about (Baker, 2003). They have to know how to maintain that social engagement for a successful social interaction to occur (Baker, 2003; Myles, 2003). The learner's inability to see the situation from that of their peers is detrimental because they cannot understand how the peer feels and they cannot keep the interaction going. Teaching perspective-taking skills is of great benefit to the learner with ASD. It helps the learner problem solve through a variety of social situations by viewing how others may feel or act and determine why a social interaction was successful or unsuccessful. Instruction in this area may help the learner to understand how his behavior is received by others and what he needs to do to have successful interactions.

Autistics may have restricted and repetitive patterns of interest (American Psychiatric Association, 2013; Cunningham & Schreibman, 2008) and may engage in a variety of challenging behaviors (e.g., aggression, self-injury) that negatively impact social interactions with their peers (American Psychiatric Association, 2013; Fitzpatrick et al., 2016). These may include stereotypic interests and behaviors that may make others uncomfortable such as smelling people's hair, making physical movements with their bodies or objects, and engaging in repeated vocal behavior. Students with ASD may engage in challenging behavior related to being unable to self-regulate and this can impair their ability to successfully inhibit behavior that is embarrassing or frightening to their peers or dangerous such as screaming when angry, hitting themselves or others, or throwing materials in the classroom (Dominick et al., 2007; Matson et al., 2008). Social withdrawal may also be seen, and may not be conducive to a successful social interaction. Peers may not have the patience for this type of behavior, may misconstrue this behavior as lack of interest, or worse yet, judge the learner with ASD as odd and not want to interact with them. Intervention should be multifaceted and should include the training of teachers and peers, the creation of an inclusive and welcoming environment for all, and the provision of interventions to help the child with ASD develop skills to best navigate the challenges of the environment that are most formidable for them.

In school settings, individual and group instructional sessions are typically structured and individualized goals are implemented. The objective in the 1:1 session is to teach a new skill and to practice so that the learner can successfully use that skill later with peers in social situations. Individual sessions allow for the introduction of a concept, practice in a context with maximal control, and the ability to work through difficulties in a more private setting. Small group sessions involving approximately two to six students can assist with skill acquisition, can provide practice opportunities, and can build fluency in a skill area (Baker, 2003; Palmen et al., 2008). Skills can also be addressed in small groups in the student's typical learning or social environment by organizing, facilitating, and practicing social interactions. The students in small groups vary. For instance, there may be a small group of three students with autism who are all working on self-regulation skills while playing games. Alternatively, the small group may consist of students with autism and neurotypical peers. In this case, the exposure to typical peers may also provide some modeling of appropriate skills (see section "Peer-Mediated").

Teachers may find it useful to target a specific skill or set of social skills within the classroom environment to address the needs of one or several students in a classroom (Baker, 2003; Kamps et al., 1992, 1994; Weiss & Harris, 2001). For instance, the teacher may instruct the class in how to pay someone a compliment or how to join play or conversation. There may be students in the class who are fluent in the targeted social skill and serve as models to others. The skill would be monitored by the teacher, who would provide feedback and reinforcement for engaging in the target behavior. An incentive system may be implemented to motivate students to engage in the social skill, which would likely increase the frequency of the skill and exposure to the students who need to develop and demonstrate the skill. Implementing a class-wide intervention is especially helpful to encourage frequent practice, generalization, and maintenance of skills in the student's natural environment (Bellini et al., 2007; Gresham et al., 2001).

For students with ASD to benefit from social skills training in schools, the interventions must be individualized, evidence-based, frequently provided, and flexible. Commercially available programs and assessments are available (e.g., Laugeson & Frankel, 2010; McGinnis, 2012; Taubman et al., 2011) to ensure individualization and evidence-based intervention. Teaching sessions should be implemented consistently, throughout the school year. Instruction should be adequate to address individual needs; the frequency and duration of sessions should be tailored to each learner. Ideally, social skills interventions should be implemented in the learner's natural environment to gain the most benefit (Bellini et al., 2007), so finding ways to embed it into classroom routines is recommended.

The school environment provides opportunities for structured and naturalistic learning for children to develop and practice social skills with their peers (Lang et al., 2011; Licciardello et al., 2008; Thomas & Bambera, 2020). Social skills can be targeted in a wide variety of settings within the school and during both structured and less-structured lessons and activities. With the various settings and instructional contexts available, teachers and other professionals have the ability to focus on the individual, specific needs of each student.

Adolescents and Adults

The World Health Organization divided Quality of Life (QoL) into six key domains physical, psychological, level of independence, social, environment, and beliefs; all of which are deemed necessary to address an "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" (World Health Organization, 2012, p. 11). Parenti et al. (2019) suggest that practitioners should promote QoL as a priority by ensuring integration in the learning environment, goal development, assessment of program, and referencing QoL as critical to all stakeholders. Social success is a key component of QoL as it is embedded as its own domain and linked to each of the other domains. Despite how significant social success relates to QoL, there exists an insufficient quantity of literature on social skill development for autistic adults. Spain and Blainey's (2015) systematic review set out to investigate the efficacy of autistic social skill groups. A total of five studies met their criteria for their review.

By way of comparison, there have been quadruple the number of studies for vocational skills interventions within a 5 year span (Seaman & Cannella-Malone, 2016). The reason for such paucity in the literature could be due to a number of factors. For starters, most social skills interventions are geared toward autistic participants who are of school age and not adults (Barnhill, 2007; Shattuck et al., 2020). By the time an autistic student reaches high school, social communication is often undervalued as a critical skill to teach (Kucharczyk et al., 2015; Wong et al., 2015) with a greater focus on teaching skills related to transition from school to adulthood (Gerhardt & Lainer, 2011; Hendricks & Wehman, 2009; Schall et al., 2012; Wehman et al., 2014). After high school there is more attention given to pre employment, workplace performance, and job retention (Chen et al., 2015; Gerhardt et al., 2014; Hagner et al., 2014; Lancioni & O'Reilly, 2001; Lattimore et al., 2002; Lerman et al., 2017; Parsons et al., 2016; Seaman & Cannella-Malone, 2016; Sherron Targett & Wehman, 2009) and interventions that promote greater independence, safety, and daily living skills in residential settings (Cavalari & Romanczyk, 2012; Gianotti et al., 2020; Markowitz, 2015; Smith & Sherron Targett, 2009; United States Department of Health and Human Services, 2018; Veazey et al., 2016). The reality is social communication skills cannot simply cease to be a priority once an autistic student enters high school; rather it must be cultivated and expanded upon in order for that student to have any chance of succeeding in their subsequent settings whether they enter an educational institution, the workforce or residential environment.

Social skills are essential for developing relationships and being a member of a community. The unfortunate reality is that without proper support or continued social skills training, many autistic adults have very few friends relative to the allistic (i.e., nonautistic) population (Aguirre et al., 2015). Hofvander et al. (2009) found that compromised social skills resulted in unemployment, being bullied, and poor relationship history as well as higher instances of depression, substance abuse, and anxiety. Lugnegård et al. (2011) study reported that 70% of autistic adults met the criteria for having experienced at least one episode of major depression, while an estimated 50% have an anxiety disorder. By the time an autistic individual reaches adulthood, the cumulative effects of these comorbid conditions that are linked with social deficits and a potential history of being a target for bullying contribute to lack of desire to be social or disbelief that reinforcement is available in social situations. As a result, many autistic adults may opt to be withdrawn socially due to a history of punishment in social situations, low self-esteem, and anxiety (Mazurek, 2014). In many cases, a life of isolation and loneliness as an accepted reality, which limits willingness to pursue social skills interventions coupled with extremely low supply.

As mentioned earlier, unemployment across the autistic population is in large part due to social skill deficits, an insufficient number of organizations supporting a neurodiverse workforce, and poor vocational skills training (Shattuck et al., 2020). Lerman et al. (2017) looked to improve autistic employee social skills by: targeting confirming statements, manding for assistance to complete a task and to access a missing item, appropriately responding to corrective feedback, and informing a designated person when the task was completed. These are all targets that will promote behavior that would be deemed essential in order to promote workplace efficiency and independence. Without these skills, the autistic employee risks being prompt dependent (e.g., waiting for a colleague to come when help is needed or to transition to the next task) which is known to be a limitation for continued employment and generalization of job responsibilities (Hendricks, 2010; Lancioni & O'Reilly, 2001). A successful work environment, from the perspective of any employee, is more than greetings and accessing assistance when needed. It is paramount that in addition to these skills, other skills related to appropriate workplace social communication are addressed. Hillier et al. (2007, 2011) developed the Aspirations program which focuses on social and vocational targets as an attempt to prepare autistic individuals for the workforce. Within the program, there is a focus on social communication, relationships, and participation in social events. They found that there was a reduction in anxiety (State-Trait Anxiety Inventory; Spielberger et al., 1983) and depression (Beck Depression Inventory; Beck et al., 1996) by improving understanding of social interactions through sharing personal experiences and listening to those of others; by practicing receiving and giving advice, and by navigating social challenges through group discussions and role-playing (Hillier et al., 2011). These strategies may provide ways in which social skills can be promoted in workplace settings too. Many autistic employees have been known to have strong mathematical, technological, and visual performance skills; be meticulous, highly motivated, outcome-oriented, skilled doing tedious work tasks, following guidelines and policies as written, honest, punctual; and have a strong commitment to the organization and colleagues. Social communication can be a challenge, but it should not be a barrier to entering the workforce. Another key to success, that cannot be overstated, is the responsibility for workplaces to engage in behaviors that reinforce an organizational culture that demonstrates patience and respect.

Other strategies that are known to be effective for autistic adults both in the workforce and outside the workforce are the use of several ABA strategies. Any intervention begins with a thoughtful individual needs assessment. It is critical that the social skills being taught are socially significant to the adult being taught and their opinion should be sourced throughout the intervention to ensure that the targets are of value as well as the presentation of the content is satisfactory. Another effective strategy is to develop and carry written reminders that support successful interactions in the workplace. This can be effective in limiting the number of times one says, “good morning” (e.g., you could have a checklist and after providing your initial greeting of the day, the individual checks off the name and knows not to wish them “good morning again”), a reminder to keep one’s mouth closed when chewing, speaking with an appropriate volume or standing at an appropriate distance when conversing, accepting feedback, or limiting the amount of personal information that is shared by having a list of topics that are off limit (Smith & Sherron Targett, 2009). Additional known effective strategies that can lead to markedly improved social skill outcomes are: video modeling, role playing, practice in the natural environment, and social skills training. A reviewed adult social skills program is the UCLA Program for the Education and Enrichment of Relational Skills (PEERS). It is a structured social communication program which targets conversation skills, friendships, humor, managing teasing and bullying, peer rejection, self-advocacy skills, managing conflict, as well as teaching dating skills (Gantman et al., 2011; McVey et al., 2016).

In addition to social skills to improve outcomes in work and navigating the social world; Autistic adults have a right to have the same relationship outcomes as the allistic population which include sexual intercourse, intimacy, and marriage. In many cases this will require specialized sexuality instruction that will include an ability to report sexual abuse, engage in appropriate sexual behavior, sexual health and hygiene training, as well as understanding relationships, intimacy, and understanding one’s sexual wellbeing (Travers & Schaefer Whitby, 2015). Sexual expression is aligned with self-determination and must be allowed to flourish, if desired. It is essential that practitioners who have had significant training and developed competence in teaching sexuality/sexual behavior and sexual health be recruited to teach autistic adults these skills and avoid potential harm that can inadvertently occur if attempted by untrained health care workers. There exists many useful curricula and resources to guide trained practitioners in scaffolding this content by targeting private vs. public, puberty, relationships, consent, sexual anatomy, dating, sexual orientation and sexual identity, sexual comfort and awareness, and safety (Davis et al., 2016; Grove et al., 2018; Henault, 2006; Lafferty et al., 2012; Organization for Autism Research, 2018; Sala et al., 2019; Stein & Dillenburger, 2017; Taylor & Davis, 2007).

Teaching Social Skills in a Group Setting

Social skills can also be effectively taught in group settings such as behaviorally based social skills groups (Leaf et al., 2017a). Social skills groups can be particularly helpful to target and teach social behavior since other children are present in the group. This increases opportunities to target initiating, responding, conversation skills, play skills, and other social behavior. There have been numerous studies that have evaluated the effectiveness of behaviorally based social skills groups and they have been found to be an effective and efficient setting to teach social behavior (Reichow & Volkmar, 2010; White et al., 2007).

Locations & Sessions

Social skills groups can be successfully conducted in private clinic settings (e.g., Leaf et al., 2017b), school settings (e.g., Williams, 1989), community settings (e.g., Webb et al., 2004), or university classrooms or clinics (e.g., Barnhill et al., 2002; Laugeson et al., 2009). When conducting a social skills group, it is recommended that the group meet at least once a week, although more sessions per week is recommended (Leaf et al., 2017a). Social skills group sessions do not need to be long in duration since it is easier to target many social behaviors in a short amount of time due to the group setting. Typically groups last anywhere from 1–3 h with 2 h being the recommended duration (Leaf et al., 2017a).

Variables to Consider

There are several important factors to consider when targeting social skills in a group setting. The first is the composition of the group and the prerequisite skills of the learners in the groups (Leaf et al., 2020). Prerequisite skills often necessary for children to be successful in learning social skills in group settings are having low rates of challenging behavior and high rates of learning-how-to-learn behaviors (Leaf et al., 2020). Some learning-how-to-learn behaviors that may be necessary prerequisites include attending, learning from feedback, imitation, observational learning, and being able to sit independently (Leaf et al., 2020). The composition of the group should also be considered in terms of the ages of the group members, complimentary social skill strengths and deficits, similar communication skill levels, and the common priority skills for the group (Leaf et al., 2020). Other variables to consider in a group setting are the teacher to student ratio, the size of the group, and the interventions used within the group. Student to teacher ratio and the size of the group will likely vary based on the participants in the group and the level of support required for the learners to be successful in the group. Lower to student-teacher ratios are likely to be needed if the learners require more prompting, shadowing, or 1:1 pull out to practice certain social behaviors. The ratio of students to teacher can increase as learners are successful in the group and less individualized support is required (Leaf et al., 2020). As the group grows, this also aligns closer to classroom settings and classroom instruction which can be a great opportunity to generalize and target skills also commonly used in school settings. Finally, the interventions used in the group setting should be considered. Interventions used in group settings should be based on the principles of applied behavior analysis and be evidence based (Leaf et al., 2017a). Some common procedures used in group settings include discrete trial teaching (e.g., Taubman et al., 2001), video modeling (e.g., Wang & Koyama, 2014), incidental teaching (e.g., Hart & Risley, 1975), script fading (e.g., Pollard et al., 2012), behavioral skills training (e.g., Miltenberger et al., 2009), the teaching interaction procedure (e.g., Leaf et al., 2015b), social discrimination programs (e.g., Leaf et al., 2016), and peer-mediated interventions (e.g., Odom et al., 1985).

Interventions for Teaching Social Skills

Due to the importance of social behavior and the deficits in social-communication commonly found in children with ASD, behavior analytic interventions have been created to teach and strengthen social behavior in order for children to navigate and access social reinforcers in their environment. Children and adolescents diagnosed with ASD often express a desire for more frequent social interactions but may lack the necessary skills to initiate and engage in social interactions (Bauminger & Kasari, 2000). It is critical that evidence-based strategies are used to teach these important social behaviors. The field of autism intervention is often confronted with pseudoscientific and antiscience interventions that claim to be effective to teach skills or even "cure" autism but children do not learn from these interventions and caregivers often end up wasting time, money, and emotions on these unproven interventions (Green, 1996). ABA interventions that are evidence-based are those that incorporate the best scientific evidence, relevant clinical experience of the interventionist, and patient values and preferences (Smith, 2013). Outlined below are common nonevidence-based interventions that are often used to teach social skills as well as procedures that would be considered evidence-based practices and can be used to teach social skills effectively and efficiently.

Common Nonevidence-Based Interventions

Social Stories

Social Stories™ are an intervention first described by Gray and Garand in 1993 as an intervention than can be used to teach and increase social behavior for autistic individuals. Gray and Garand (1993) recommended the use of Social Stories™ to teach social behavior to individuals with ASD since other traditional methods may be confusing. According to Gray and Garand (1993) Social Stories™ improve social behavior by teaching individuals to answer questions about who, when, where, why, and what with respect to the target social behavior. This comprehension along with the reading the Social Story™ leads to improvement in social behavior in the natural environment. Guidelines and recommendations were provided regarding the best way to implement Social Stories™ including: (a) using Social Stories™ with higher cognitive abilities (Gray & Garand, 1993), (b) stories should be written from the students perspective, (c) stories should be individualized, (d) stories should be written to the student's individual comprehension level, (e) consist of specific sentence types, (f) stories should be read aloud to the learner while the learner is seated next to the reader, and (g) the story should be read at least once a day (Gray & Garand, 1993). This article describing Social Stories™ and claiming their effectiveness included no empirical data and was just a description of the process to implement Social Stories™ (Leaf & Ferguson, 2017).

Since then, Social Stories™ have been the subject of many experimental studies to target a variety of behaviors for autistic learners and they are commonly espoused as an effective intervention for children with ASD. But what does the research say about their effectiveness? Reynhout and Carter (2006) analyzed 16 studies that used Social Stories™ to teach skills to learners with ASD. The authors found highly variable effect sizes, highly variable methodology (with researchers often not following a protocol) and concluded that the data indicated the procedure was ineffective. Styles (2011) analyzed 51 Social Story™ studies and found methodological limitations throughout and recommended further investigation prior to recommending Social Stories™ as an evidence-based practice. Reynhout and Carter (2011) did a follow-up review on Social Stories™ and found variability in results and only a small clinical effect on behavior across 62 articles. Leaf et al. (2015a) conduced a review of the research on Social Stories™ and found that 92.7% of the studies analyzed were unable to offer a convincing demonstration of the effectiveness of Social Stories™. More recently, Milne et al. (2020) conducted an updated review on the literature on Social

Stories™ and again concluded that the research was not convincing as to their effectiveness and any time a study has compared Social Stories™ to another behavior analytic intervention, the other intervention was found to be more effective and efficient.

Overall, the meta-analyses and reviews on the Social Story™ research has found the methodology to be flawed, has found little demonstration of effectiveness across studies, and often Social Stories™ need to be combined with additional behavior analytic procedures in order to be effective (Leaf & Ferguson, 2017). With other evidence-based social skill interventions available for learners with ASD, Social Stories™ should not be the go-to intervention to teach social behavior to autistic children.

Social Thinking

Social Thinking® is an intervention that is based on central coherence theory, executive dysfunction, and theory of mind to teach individuals with ASD to behave and "think" socially (Winner, 2007). Social Thinking® is a curriculum now commonly seen in school districts to teach children with ASD social skills, but it is important to examine the evidence behind this approach. There have only been three studies published on Social Thinking® (i.e., Crooke et al., 2008; Koning et al., 2013; Lee et al., 2016). Proponents of Social Thinking® will often cite other research, but these are usually unpublished dissertations and theses or commentary papers on Social Thinking® (Leaf et al., 2018). When analyzing the available peer-reviewed research on Social Thinking® researchers have concluded that there is not enough data to assert that Social Thinking® is effective (Leaf et al., 2016, 2018). Not only has Social Thinking® not been found to be effective based on the available evidence, but it has also been noted as a pseudoscience intervention (Leaf et al., 2016, 2018) and has been listed as an unestablished intervention by the National Autism Center (2015). With the current available evidence, Social Thinking™ is not an evidence-based practice and should not be used to teach social behavior to children with ASD.

Common Evidence-Based Interventions

Behavioral Skills Training and Teaching Interaction Procedure

Behavioral skills training (BST) and the Teaching Interaction Procedure (TIP) are two interventions that have been found to be effective to teach social skills to children with ASD. BST and TIP are similar procedures that incorporate instructions, modeling, and role-play with a couple distinctions between the two procedures (Leaf et al., 2015b). BST includes four components: instruction, modeling, rehearsal/role-play, and feedback (Miltenberger et al., 2009, 2017). Whereas the TIP includes labeling and identifying the target skill, providing a meaningful rationale, giving a description of the skill, outlining the task analysis of the skill, providing a correct and incorrect demonstration of the target skill, having the learner role-play/practice the skill, and providing feedback throughout (Cihon et al., 2017). Both procedures have a long history of effectiveness for teaching social skills to learners with ASD. The TIP has been used to teach children with ASD social skills such as greetings (e.g., Leaf et al., 2009), making on-topic statements (e.g., Leaf et al., 2009), expressing empathy (e.g., Leaf et al., 2010), showing appreciation (e.g., Leaf et al., 2010), conversational basics (e.g., Dotson et al., 2010), game-play (e.g., Oppenheim-Leaf et al., 2012), winning graciously (e.g., Kassardjian et al., 2013), turn—taking (e.g., Ferguson et al., 2013), and many other social skills. BST has been used to effectively teach children with ASD social skills such as nonvocal and vocal communication skills (e.g., Nuernberger et al., 2013), conversation skills (e.g., Kornacki et al., 2013), perspective taking (e.g., Radley et al., 2014), problem solving skills (e.g., Radley et al., 2014), and many others. Additionally, both BST and the TIP have been used in group settings, one-to-one settings, home, clinic, and school settings successfully (Cihon et al., 2017; Miltenberger et al., 2017).

Video Modeling

Video modeling or video-based instruction is an evidence-based behavior analytic procedure that involves creating a video of a person modeling the exact way to engage in a target behavior and then showing the learner the video of the model (Ayres et al., 2017; LeBlanc et al., 2003). Video modeling is often combined with other behavior analytic strategies such as reinforcement, rehearsal, and feedback (LeBlanc et al., 2003). The video itself allows practitioners to accentuate and highlight key steps to a social skill, and the child is able to watch the video as many times as they would like. Video modeling has been used to successfully teach social skills to learners with ASD including initiating conversations (e.g., Nikopoulos & Keenan, 2004), giving compliments (e.g., Macpherson et al., 2014), play skills (e.g., MacDonald et al., 2005), perspective taking skills (e.g., LeBlanc et al., 2003), and many more. Some variables to consider when implementing video modeling include learner prerequisite attending and imitation skills, how the video will be created, what perspective will be used, if narration will be used, who the instructional agent will be, and if other behavior analytic components will be incorporated along with video modeling (Ayres et al., 2017).

Visual Learning Strategies

Visual learning procedures that have been used to successfully teach autistic children social behavior include photographic activity schedules, social scripts, and script fading (Higbee & Sellers, 2017). Photographic activity schedules is a technique that includes visual/pictorial cues that are paired with prompt fading procedures to help children with ASD learn and complete progressively longer and more complex skills (Higbee & Sellers, 2017). Social scripts and script fading procedures are visual or auditory scripts/cues that are used to prompt the learner to engage in the targeted skill. Those social scripts/cues are then faded until the learner is engaging in the targeted skill independently (Higbee & Sellers, 2017). Photographic activity schedules have been used to successfully teach play skills on the playground (e.g., Machalicek et al., 2009), leisure activities (e.g., MacDuff et al., 1993), and other vocational and adaptive skills (Higbee & Sellers, 2017). Social scripts and script fading procedures have been used to teach social skills such as vocal responses, social interactions, comments, question asking, empathetic statements, manding for social attention, and many others (Higbee & Sellers, 2017). Social scripts and script fading are considered to be an empirically supported treatment (Akers et al., 2016) for learners with ASD and an evidence-based practice (Wong et al., 2015). Resources and books are available (e.g., McClannahan & Krantz, 2005) to help practitioners develop and implement script fading interventions to teach social skills in effective and efficient ways to children with ASD and more research continues to be conducted on their effectiveness.

Peer-Mediated

Peer-mediated interventions aim to increase social communication behaviors for learners with ASD through the manipulation of contingencies to promote social interactions through the use of peer instruction to promote the interactions (Kamps et al., 2017). Peer-mediated interventions are considered to be an evidence-based practice (National Autism Center, 2015) and have decades of research supporting their effectiveness to teach social skills to autistic children. Peer-mediated interventions typically include four to five peers that model appropriate and good social-communication skills, are well liked by other peers, and have positive social interactions with the child with ASD (Sperry et al., 2010). The group of peers are then provided training in how to support their classmate/peer with ASD. Training often is provided on how to provide assistance and how to keep interactions going through the use of direct instruction, practice, and feedback (Sperry et al., 2010). Then structured teaching sessions with the peers and child with ASD are conducted in structured and naturalistic classroom settings (Sperry et al., 2010). These peer-mediated strategies have been effective in promoting social interactions, responses, imitations, joint attention, social communication skills, and more for children with ASD (Kamps et al., 2017; Laushey & Heflin, 2000; Mathews et al., 2018). Additionally, since peer-mediated strategies often occur in naturalistic classroom settings, school-aged children with ASD are able to learn and acquire social skills in the setting in which they typically spend the majority of their day (i.e., school classroom).

Peer-mediated interventions expose the learner with ASD to instruction and modeling from a peer and are valuable in several ways. One method uses the peer as a model, so that the learner is exposed to the behavior, language, and rules that are expected and reinforced in a peer social interaction. For a student with ASD who is ready to practice the skills that he has learned, a peer group provides this opportunity. Additionally, peers can be trained to implement strategies to encourage and improve social interactions with learners with ASD (DiSalvo & Oswald, 2002; Kasari et al., 2012; Krebs et al., 2010; Mason et al., 2014; Owen-DeSchryver et al., 2008). This can be addressed based on individual learner needs such as teaching the peer how to respond to repetitive questions and redirecting the learner with ASD to move to the next step in a conversation. A learner who can benefit from peer-mediated intervention is ready to work on the fluency and generalization of social skills. This type of instruction helps to support generalization and maintenance of skills by practicing skills in the natural environment with peers. Such practice opportunities also facilitate friendships and offer additional opportunities for social interaction.

Conclusion

Social skills instruction is a common focus of ABA intervention. ABA has been, and continues to be, an excellent resource for building skills in social navigation, especially because of the foundational values on compassionate care and the use of evidence-based interventions. In recent years, ABA interventionists have approached social skills instruction more judiciously, recognizing the importance of respecting client and stakeholder priorities and selecting skills that enhance valued outcomes.

Assessment and goal selection are vital. For different ages, there are pivotal and central skills that may be appropriate to address, and that lead to enhanced relationships and other outcomes. For very young children, building skills in joint attention and social referencing can lay the foundation for learning through observation. For school-aged children, a variety of contexts can be used to build skills in increasingly natural and diverse contexts, preparing the learner for the myriad of interactions they will encounter in adulthood. For adolescents and adults, the lens must be widened to examine skills needed to achieve self-determined outcomes, especially in social connection and employment.

A wide variety of evidence-based procedures exist to build skills in these areas. Many effective procedures also work for many other skills, and include the use of visual strategies, behavior skills training, and video modelling. Incorporating peers in interventions is commonly done, and has been shown to have associated benefits for fostering social connections.

We began the chapter referencing a seismic shift in the landscape of social skills intervention, and we will end on that note as well. Indeed, as we build bridges with the autistic community, it is essential that we listen to the feedback and perspective from these individuals, and that we endeavor to refine our methods, measures, and outcomes accordingly.

References

Aguirre, A., O'Neill, J., Rehfeldt, R. A., & Boyer, V. (2015). Behavioral interventions for complex communication and social skills in adults with autism spectrum disorders. In M. Tincani & A. Bondy (Eds.), *Autism spectrum disorders in adolescents and adults: Evidence-based and promising interventions* (pp. 93–117). Guilford Publications.

Akers, J. S., Pyle, N., Higbee, T. S., Pyle, D., & Gerencser, K. R. (2016). A synthesis of script fading effects with individuals with autism spectrum disorder: A 20-year review. *Review Journal of Autism and Developmental Disorders, 3*(1), 1–17. https://doi.org/10.1007/s40489-015-0062-9

Almeida, C., & Ellis, J. T. (2014). *Socially savvy: An assessment and curriculum guide for young children*. Different Roads to Learning.

American Psychiatric Association (Ed.). (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Ayres, K. M., Travers, J., Shepley, S. B., & Cagliani, R. (2017). Video-based instruction for learners with autism. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder* (pp. 223–239). Springer. https://doi.org/10.1007/978-3-319-62995-7_14

Baker, J. (2003). *Social skills training for children and adolescents with Asperger Syndrome and social-communication problems*. AAPC Publishing.

Baker, J. (2008). *No more meltdowns: Positive strategies for dealing with and preventing out-of-control behavior*. Future Horizons, Inc.

Barnhill, G. P. (2007). Outcomes in adults with Asperger syndrome. *Focus on Autism and Other Developmental Disabilities, 22*(2), 116–126. https://doi.org/10.1177/10883576070220020301

Barnhill, G. P., Cook, K. T., Tebbenhamp, K., & Myles, B. S. (2002). The effectiveness of social skills intervention targeting nonverbal communication for adolescents with asperger syndrome and related pervasive developmental delays. *Focus on Autism and Other Developmental Disabilities, 17*, 112–118. https://doi.org/10.1177/10883576020170020601

Barton, E. E. (2010). Development of a taxonomy of pretend play for children with disabilities. *Infants and Young Children, 23*(4), 247–261.

Bauminger, N., & Kasari, C. (2000). Loneliness and friendship in high-functioning children with autism. *Child Development, 71*(2), 447–456. https://doi.org/10.1111/1467-8624.00156

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck depression inventory*. The Psychological Corporation.

Behavior Analyst Certification Board. (2020). *Ethics code for behavior analysts*. Author.

Bellini, S., Peters, J. K., Benner, L., & Hopf, A. (2007). A meta-analysis of school-based social skills interventions for children with autism spectrum disorders. *Remedial and Special Education, 28*(3), 153–162. https://doi.org/10.1177/07419325070280030401

Bradshaw, J., Steiner, A. M., Gengoux, G., & Koegel, L. K. (2015). Feasibility and effectiveness of very early intervention for infants at-risk for autism spectrum disorder: A systematic review. *Journal of Autism and Developmental Disorders, 45*(3), 778–794. https://doi.org/10.1007/s10803-014-2235-2

Cavalari, R. N. S., & Romanczyk, R. G. (2012). Caregiver perspectives on unintentional injury risk in children with autism spectrum disorder. *Journal of Pediatric Nursing, 27*(6), 632–641. https://doi.org/10.1016/j.pedn.2011.07.013

Champlin, N., & Schissler, M. (2017). *Pretend play and language assessment and curriculum*. ACI Learning Centers.

Chen, J. L., Leader, G., Sung, C., & Leahy, M. (2015). Trends in employment for autism spectrum disorder: A review of the research literature. *Journal of Autism and Developmental Disorders, 2*, 115–127. https://doi.org/10.1007/s40489-014-0041-6

Cihon, J. H., Weinkauf, S. M., & Taubman, M. (2017). Using the teaching interaction procedure to teach social skills for individuals diagnosed with autism spectrum disorder. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder*. Springer. https://doi.org/10.1007/978-3-319-62995-7_18

Cooper, J. O., Heron, T. E., & Heward, W. L. (2019). *Applied behavior analysis* (3rd ed.). Pearson Education.

Costantino, J. N., & Gruber, C. P. (2012). *Social responsiveness scale* (2nd ed.). Western Psychological Services.

Crooke, P. J., Hendrix, R. E., & Rachman, J. Y. (2008). Brief report: Measuring the effectiveness of teaching social thinking to children with Asperger syndrome (AS) and high functioning autism (HFA). *Journal of Autism and Developmental Disorders, 38*(3), 581–591. https://doi.org/10.1007/s10803-007-0466-1

Cunningham, A. B., & Schreibman, L. (2008). Stereotypy in autism: The importance of function. *Research in Autism Spectrum Disorders, 2*(3), 469–479. https://doi.org/10.1016/j.rasd.2007.09.006

Davis, T. N., Machalicke, W., Scalzo, R., Kobylecky, A., Campbell, V., Pinkelman, S., Chan, J. M., & Sigafoos, J. (2016). A review and treatment selection model for individuals with developmental disabilities who engage in inappropriate sexual behavior. *Behavior Analysis in Practice, 9*, 389–402. https://doi.org/10.1007/s40617-015-0062-3

DeQuinzio, J. A., Taylor, B. A., & Tomasi, B. J. (2018). Observational learning and children with autism: Discrimination training of known and unknown stimuli. *Journal of Applied Behavior Analysis, 51*(4), 802–818. https://doi.org/10.1002/jaba.481

DiSalvo, C. A., & Oswald, D. P. (2002). Peer-mediated interventions to increase the social interaction of children with autism: Consideration of peer expectancies. *Focus on Autism and Other Developmental Disabilities, 17*(4), 198–207. https://doi.org/10.1177/10883576020170040201

Dominick, K. C., Davis, N. O., Lainhart, J., Tager-Flusberg, H., & Folstein, S. (2007). Atypical behaviors in children with autism and children with a history of language impairment. *Research in Developmental Disabilities, 28*(2), 145–162. https://doi.org/10.1016/j.ridd.2006.02.003

Dotson, W. H., Leaf, J. B., Sheldon, J. B., & Sherman, J. A. (2010). Group teaching of conversational skills to adolescents on the autism spectrum. *Research in Autism Spectrum Disorders, 4*(2), 199–209. https://doi.org/10.1016/j.rasd.2009.09.005

Ferguson, B. R., Gillis, J. M., & Sevlever, M. (2013). A brief group intervention using video games to teach sportsmanship skills to children with autism spectrum disorders. *Child & Family Behavior Therapy, 35*(4), 293–306. https://doi.org/10.1080/07317107.2013.846648

Fitzpatrick, S. E., Srivorakiat, L., Wink, L. K., Pedapati, E. V., & Erickson, C. A. (2016). Aggression in autism spectrum disorder: Presentation and treatment options.

Neuropsychiatric Disease and Treatment, 12, 1525–1538. https://doi.org/10.2147/NDT.S84585

Franchini, M., Hamodat, T., Armstrong, V. L., Sacrey, L. A. R., Brian, J., Bryson, S. E., Garon, N., Roberts, W., Zwaigenbaum, L., & Smith, I. M. (2019). Infants at risk for autism spectrum disorder: Frequency, quality, and variety of joint attention behaviors. *Journal of Abnormal Child Psychology, 47*(5), 907–920. https://doi.org/10.1007/s10802-018-0471-1

Freeman, B. J., & Cronin, P. (2017). Standardized assessment of social skills in autism spectrum disorder. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder: Assessment, curricula, and intervention* (pp. 83–96). Springer.

Gantman, A., Kapp, S. K., Orenski, K., & Laugeson, E. A. (2011). Social skills training for young adults with high-functioning autism spectrum disorders: A randomized controlled pilot study. *Journal of Autism and Developmental Disorders, 42*(6), 1094–1103. https://doi.org/10.1007/s10803-011-1350-6

Gerhardt, P. F., & Lainer, I. (2011). Addressing the needs of adolescents and adults with autism: A crisis on the horizon. *Journal of Contemporary Psychotherapy, 41*(1), 37–45. https://doi.org/10.1007/s10879-010-9160-2

Gerhardt, P. F., Cicero, F., & Mayville, E. (2014). Employment and related services for adults with ASD. In F. Volkmar, S. J. Rogers, R. Paul, & K. A. Pelphrey (Eds.), *Handbook of autism and pervasive developmental disorders* (4th ed., pp. 907–917). Wiley.

Gianotti, J., Kahl, T., Harper, J. M., & Luiselli, J. K. (2020). Behavioral safety assessment and intervention among residential care providers of students with intellectual and developmental disabilities. *Journal of Developmental and Physical Disabilities, 33*(5), 789–798. https://doi.org/10.1007/s10882-020-09773-7

Goldiamond, I. (1974). Toward a constructional approach to social problems: Ethical and constitutional issues raise by applied behavior analysis. *Behaviorism, 2*(1), 1–84.

Gray, C. A., & Garand, J. D. (1993). Social stories: Improving responses of students with autism with accurate social information. *Focus on Autistic Behavior, 8*(1), 1–10. https://doi.org/10.1177/108835769300800101

Green, G. (1996). Evaluating claims about treatments for autism. In C. Maurice, G. Green, & S. C. Luce (Eds.), *Behavioral intervention for young children with autism: A manual for parents and professionals* (pp. 15–28). Pro-Ed.

Gresham, F. M., & Elliott, S. N. (2008). *Social skills improvement system: Rating scales manual*. Pearson.

Gresham, F. M., Sugai, G., & Horner, R. H. (2001). Interpreting outcomes of social skills training for students with high-incidence disabilities. *Exceptional Children, 67*(3), 331–344. https://doi.org/10.1177/001440290106700303

Grove, L., Morrison-Beedy, D., Kirby, R., & Hess, J. (2018). The birds, bees, and special needs: Making evidence-based sex education accessible for adolescents with intellectual disabilities. *Sexuality and Disability, 36*(4), 313–329. https://doi.org/10.1007/s11195-018-9547-7

Hagner, D., Dague, B. D., & Phillips, K. (2014). Including employees with disabilities in workplace cultures: Strategies and barriers. *Rehabilitation Counseling Bulletin, 58*(4), 195–202. https://doi.org/10.1177/0034355214544750

Hanley, G. P. (2010). Toward effective and preferred programming: A case for the objective measurement of social validity with recipients of behavior-change programs. *Behavior Analysis in Practice, 3*(1), 13–21. https://doi.org/10.1007/BF03391754

Hart, B., & Risley, T. R. (1975). Incidental teaching of language in the preschool. *Journal of Applied Behavior Analysis, 8*(4), 411–420. https://doi.org/10.1901/jaba.1975.8-411

Henault, I. (2006). *Asperger's syndrome and sexuality: From adolescence through adulthood*. Jessica Kingsley Publishers.

Hendricks, D. (2010). Employment and adults with autism spectrum disorders: Challenges and strategies for success. *Journal of Vocational Rehabilitation, 32*(2), 125–134. https://doi.org/10.3233/jvr-2010-0502

Hendricks, D. R., & Wehman, P. (2009). Transitions from school to adulthood for youth with autism spectrum disorders: Review and recommendations. *Focus on Autism and Other Developmental Disabilities, 24*(2), 77–88. https://doi.org/10.1177/1088357608329827

Higbee, T. S., & Sellers, T. P. (2017). Handbook of social skills and autism spectrum disorder: Assessment, curricula, and intervention. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder*. Springer.

Hillier, A., Fish, T., Cloppert, P., & Beversdorf, D. Q. (2007). Outcomes of a social and vocational skills support group for young adults on the autism spectrum. *Focus on Autism and Other Developmental Disabilities, 22*(2), 107–115. https://doi.org/10.1177/10883576070220020201

Hillier, A. J., Fish, T., Siegel, J. H., & Beversdorf, D. Q. (2011). Social and vocational skills training reduces self-reported anxiety and depression among young adults on the autism spectrum. *Journal of Developmental and Physical Disabilities, 23*(3), 267–276. https://doi.org/10.1007/s10882-011-9226-4

Hofvander, B., Delorme, R., Chaste, P., Nydén, A., Wentz, E., Ståhlberg, O., Herbrecht, E., Stopin, A., Anckarsäter, H., Gillberg, C., Råstam, M., & Leboyer, M. (2009). Psychiatric and psychosocial problems in adults with normal-intelligence autism spectrum disorders. *BMC Psychiatry, 9*(1), 35. https://doi.org/10.1186/1471-244x-9-35

Holth, P., Vandbakk, M., Finstad, J., Marie Grønnerud, E., & Mari Akselsen Sørensen, J. (2009). An operant analysis of joint attention and the establishment of conditioned social reinforcers. *European Journal of Behavior Analysis, 10*(2), 143–158. https://doi.org/10.1080/155021149.2009.11434315

Howlin, P., Baron-Cohen, S., & Hadwin, J. (1999). *Teaching children with autism to mind-read: A practical guide*. Wiley & Sons.

Isaksen, J., & Holth, P. (2009). An operant approach to teaching joint attention to children with autism. *Behavioral Interventions, 24*(4), 215–236. https://doi.org/10.1002/bin.292

Jahr, E., Eldevik, S., & Eikeseth, S. (2000). Teaching children with autism to initiate and sustain cooperative play. *Research in Developmental Disabilities, 21*(2), 151–169. https://doi.org/10.1016/S0891-4222(00)00031-7

Kamps, D. M., Leonard, B. R., Vernon, S., Dugan, E. P., Delquadri, J. C., Gershon, B., Wade, L., & Folk, L. (1992). Teaching social skills to students with autism to increase peer interactions in an integrated first-grade classroom. *Journal of Applied Behavior Analysis, 25*(2), 281–288. https://doi.org/10.1901/jaba.1992.25-281

Kamps, D. M., Barbetta, P. M., Leonard, B. R., & Delquadri, J. (1994). Classwide peer tutoring: An integration strategy to improve reading skills and promote peer interactions among students with autism and general education peers. *Journal of Applied Behavior Analysis, 27*(1), 49–61. https://doi.org/10.1901/jaba.1994.27-49

Kamps, D. M., Mason, R., & Heitzman-Powell, L. (2017). Peer mediation interventions to improve social and communication skills for children and youth with autism spectrum disorders. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder*. Springer. https://doi.org/10.1007/978-3-319-62995-7_16

Kasari, C., Rotheram-Fuller, E., Locke, J., & Gulsrud, A. (2012). Making the connection: Randomized controlled trial of social skills at school for children with autism spectrum disorders. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 53*(4), 431–439. https://doi.org/10.1111/j.1469-7610.2011.02493.x

Kassardjian, A., Rudrud, E., Taubman, M., Leaf, J. B., Edwards, A., Schulze, K., McEachin, J., & Leaf, R. (2013). Utilizing teaching interactions to facilitate social skills in the natural environment. *Education and Training in Autism and Developmental Disabilities, 48*(2), 245–257.

Kennedy, D. P., & Adolphs, R. (2014). Violations of personal space by individuals with autism spectrum disorder. *PLoS One, 9*, e103369. https://doi.org/10.1371/journal.pone.0103369

Koning, C., Magill-Evans, J., Volden, J., & Dick, B. (2013). Efficacy of cognitive behavior therapy-based social skills intervention for school-aged boys with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*(10), 1282–1290. https://doi.org/10.1016/j.rasd.2011.07.011

Kornacki, L. T., Ringdahl, J. E., Sjostrom, A., & Nuernberger, J. E. (2013). A component analysis of a behavioral skills training package used to teach conversation skills to young adults with autism spectrum and other developmental disorders. *Research in Autism Spectrum Disorders, 7*(11), 1370–1376. https://doi.org/10.1016/j.rasd.2013.07.012

Krebs, M. L., McDaniel, D., & Neeley, R. A. (2010). The effects of peer training on the social interactions of children with autism spectrum disorders. *Education, 131*(2), 393–403.

Kubina, R. M., Jr., & Yurich, K. K. (2009). Developing behavioral fluency for students with autism: A guide for parents and teachers. *Intervention in School and Clinic, 44*(3), 131–138. https://doi.org/10.1177/1053451208326054

Kucharczyk, S., Reutebuch, C. K., Carter, E. W., Hedges, S., El Zein, F., Fan, H., & Gustafson, J. R. (2015). Addressing the needs of adolescents with autism spectrum disorder: Considerations and complexities for high school interventions. *Exceptional Children, 81*(3), 329–349. https://doi.org/10.1177/0014402914563703

Lafferty, A., McConkey, R., & Simpson, A. (2012). Reducing the barriers to relationships and sexuality education for persons with intellectual disabilities. *Journal of Intellectual Disabilities, 16*(1), 29–43. https://doi.org/10.1177/1744629512438034

Lancioni, G. E., & O'Reilly, M. F. (2001). Self-management of instruction cues for occupation: Review of studies with people with severe and profound disabilities. *Research in Developmental Disabilities, 22*(1), 41–65. https://doi.org/10.1016/s0891-4222(00)00063-9

Lang, R., Kuriakose, S., Lyons, G., Mulloy, A., Boutot, A., Britt, C., Caruthers, S., Ortega, L., O'Reilly, M., & Lancioni, G. (2011). Use of school recess time in the education and treatment of children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 5*(4), 1296–1305. https://doi.org/10.1016/j.rasd.2011.02.012

Lattimore, L. P., Parsons, M. B., & Reid, D. H. (2002). A prework assessment of task preferences among adults with autism beginning a supported job. *Journal of Applied Behavior Analysis, 35*(1), 85–88. https://doi.org/10.1901/jaba.2002.35-85

Laugeson, E. A. (2013). *The PEERS® curriculum for school-based professionals*. Routledge.

Laugeson, E. A., & Frankel, F. (2010). *Social skills for teenagers with developmental and autism spectrum disorders: The PEERS treatment manual*. Routledge.

Laugeson, E. A., Frankel, F., Mogil, C., & Dillon, A. R. (2009). Parent-assisted social skills training to improve friendships in teens with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 39*(4), 596–606. https://doi.org/10.1007/s10803-008-0664-5

Laushey, K. M., & Heflin, L. J. (2000). Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders, 30*(3), 183–193. https://doi.org/10.1023/A:1005558101038

Leadbitter, K., Buckle, K. L., Ellis, C., & Dekker, M. (2021). Autistic self-advocacy and the neurodiversity movement: Implications for autism early intervention research and practice. *Frontiers in Psychology, 12*, 635690. https://doi.org/10.3389/fpsyg.2021.635690

Leaf, J. B., & Ferguson, J. L. (2017). Social Stories™: A cautionary tale. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder* (pp. 369–385). Springer. https://doi.org/10.1007/978-3-319-62995-7_22

Leaf, R. B., & McEachin, J. (1999). *A work in progress: Behavior management strategies and a curriculum for intensive behavioral treatment of autism*. DRL Books.

Leaf, J. B., Taubman, M., Bloomfield, S., Palos-Rafuse, L., Leaf, R., McEachin, J., & Oppenheim, M. L. (2009). Increasing social skills and pro-social behavior for three children diagnosed with autism through the use of a teaching package. *Research in Autism Spectrum Disorders, 3*(1), 275–289. https://doi.org/10.1016/j.rasd.2008.07.003

Leaf, J. B., Dotson, W. H., Oppeneheim, M. L., Sheldon, J. B., & Sherman, J. A. (2010). The effectiveness of a group teaching interaction procedure for teaching social skills to young children with a pervasive developmental disorder. *Research in Autism Spectrum Disorders, 4*(2), 186–198. https://doi.org/10.1016/j.rasd.2009.09.003

Leaf, J. B., Oppenheim-Leaf, M. L., Leaf, R. B., Taubman, M., McEachin, J., Parker, T., Waks, A. B., & Mountjoy, T. (2015a). What is the proof? A methodological review of studies that have utilized social stories. *Education and Training in Autism and Developmental Disabilities, 50*(2), 127–141. http://www.jstor.org/stable/24827530

Leaf, J. B., Townley-Cochran, D., Taubman, M., Cihon, J. H., Oppenheim-Leaf, M. L., Kassardjian, A., Leaf, R., McEachin, J., & Pentz, T. G. (2015b). The teaching interaction procedure and behavioral skills training for individuals diagnosed with autism spectrum disorder: A review and commentary. *Review Journal of Autism and Developmental Disorders, 2*, 402–413. https://doi.org/10.1007/s40489-015-0060-y

Leaf, J. B., Taubman, M., Milne, C., Dale, S., & Leaf, J. (2016). Teaching social communication skills using cool versus not cool procedure plus role-playing and a social skills taxonomy. *Education and Treatment of Children, 39*(1), 44–63.

Leaf, J. B., Cihon, J. H., & Ferguson, J. L. (2017a). Behaviorally based social skills groups. In F. R. Volkmar (Ed.), *Encyclopedia of autism spectrum disorders*. Springer. https://doi.org/10.1007/978-1-4614-6435-8_102214-1

Leaf, J. B., Leaf, J. A., Milne, C., Taubman, M., Oppenheim-Leaf, M., Torres, N., Townley-Cochran, D., Leaf, R., McEachin, J., & Yoder, P. (2017b). An evaluation of a behaviorally based social skills group for individuals with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*, 243–259. https://doi.org/10.1007/s10803-016-2949-4

Leaf, J. B., Cihon, J. H., Ferguson, J. L., Taubman, M., Leaf, R., & McEachin, J. (2018). Social Thinking®, pseudoscientific, not empirically supported, and non-evidence based: A reply to Crooke and Winner. *Behavior Analysis in Practice, 11*(4), 456–466. https://doi.org/10.1007/s40617-018-0241-0

Leaf, J. B., Milne, C. M., Leaf, J. A., Rafuse, J., Cihon, J. H., Ferguson, J. L., Oppenheim-Leaf, M. L., Leaf, R., McEachin, J., & Mountjoy, T. (2020). *The autism partnership method: Social skills groups*. Different Roads to Learning.

LeBlanc, L. A., Coates, A. M., Daneshvar, S., Charlop-Christy, M. H., Morris, C., & Lancaster, B. M. (2003). Using video modeling and reinforcement to teach perspective-taking skills to children with autism. *Journal of Applied Behavior Analysis, 36*(2), 253–257. https://doi.org/10.1901/jaba.2003.36-253

Lee, K. Y. S., Crooke, P. J., Lui, A. L. Y., Kan, P. P. K., Mark, Y.-M., van Hasselt, C. A., & Tong, M. C. F. (2016). The outcome of a social cognitive training for mainstream adolescents with social communication deficits in a Chinese community. *International Journal of Disability, Development and Education, 63*(2), 201–223. https://doi.org/10.1080/1034912X.2015.1065960

Lerman, D. C., White, B., Grob, C., & Laudont, C. (2017). A clinic based assessment for evaluating job related social skills in adolescents and adults with autism. *Behavior Analysis in Practice, 10*(4), 323–336. https://doi.org/10.1007/s40617-017-0177-9

Licciardello, C. C., Harchik, A. E., & Luiselli, J. K. (2008). Social skills intervention for children with autism during interactive play at a public elementary school. *Education and Treatment of Children, 31*(1), 27–37. https://doi.org/10.1353/etc.0.0010

Lugnegård, T., Hallerbäck, M. U., & Gillberg, C. (2011). Psychiatric comorbidity in young adults with a clinical diagnosis of Asperger syndrome. *Research in Developmental Disabilities, 32*(5), 1910–1917. https://doi.org/10.1016/j.ridd.2011.03.025

MacDonald, R., Clark, M., Garrigan, E., & Vangala, M. (2005). Using video modeling to teach pretend play to children with autism. *Behavioral Interventions, 20*(4), 225–238. https://doi.org/10.1002/bin.197

MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26*(1), 89–97. https://doi.org/10.1901/jaba.1993.26-89

Machalicek, W., O'Reilly, M., Chan, J. M., Rispoli, M., Lang, R., Davis, T., Shogren, K., Sorrells, A., Lancioni, G., Sigafoos, J., Green, V., & Langthorne, P. (2009). Using videoconferencing to support teachers to conduct preference assessments with students with autism and developmental disabilities. *Research in Autism Spectrum Disorders, 3*(1), 32–41. https://doi.org/10.1016/j.rasd.2008.03.004

Macpherson, K., Charlop, M. H., & Miltenberger, C. A. (2014). Using portable video modeling technology to increase the compliment behaviors of children with autism during athletic group play. *Journal of Autism and Developmental Disorders, 45*(12), 3836–3845. https://doi.org/10.1007/s10803-014-2072-3

Markowitz, C. (2015). Aging, estate planning, and funding services for adults with autism spectrum disorders.

In M. Tincani & A. Bondy (Eds.), *Autism spectrum disorders in adolescents and adults: Evidence-based and promising interventions* (pp. 288–308). Guilford Publications.

Mason, R., Kamps, D., Turcotte, A., Cox, S., Feldmiller, S., & Miller, T. (2014). Peer mediation to increase communication and interaction at recess for students with autism spectrum disorders. *Research in Autism Spectrum Disorders, 8*(3), 334–344. https://doi.org/10.1016/j.rasd.2013.12.014

Mathews, T. L., Vatland, C., Lugo, A. M., Koenig, E. A., & Gilroy, S. P. (2018). Training peer models to promote social skills: Considerations for practice. *Focus on Autism and Other Developmental Disabilities, 33*(3), 160–170. https://doi.org/10.1177/1088357617735814

Matson, J. L., Matson, M. L., & Rivet, T. T. (2007). Social-skills treatments for children with autism spectrum disorders: An overview. *Behavior Modification, 31*(5), 682–707. https://doi.org/10.1177/0145445507301650

Matson, J. L., Wilkins, J. W., & Macken, J. (2008). The relationship of challenging behaviors to severity and symptoms of autism spectrum disorders. *Journal of Mental Health Research in Intellectual Disabilities, 2*, 29–44. https://doi.org/10.1080/19315860802611415

Mazurek, M. O. (2014). Loneliness, friendship, and well-being in adults with autism spectrum disorders. *Autism, 18*(3), 223–232. https://doi.org/10.1177/1362361312474121

McClannahan, L. E., & Krantz, P. J. (2005). *Teaching conversation to child with autism: Scripts and script fading*. Woodbine House.

McGinnis, E. (2012). *Skillstreaming the elementary school child: A guide for teaching prosocial skills* (3rd ed.). Research Press.

McVey, A. J., Dolan, B. K., Willar, K. S., Pleiss, S., Karst, J. S., Casnar, C. L., Caiozzo, C., Vogt, E. M., Gordon, N. S., & Van Hecke, A. V. (2016). A replication and extension of the PEERS® for young adults social skills intervention: Examining effects on social skills and social anxiety in young adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*(12), 3739–3754. https://doi.org/10.1007/s10803-016-2911-5

Milne, C. M., Leaf, J. B., Cihon, J. H., Ferguson, J. L., McEachin, J., & Leaf, R. (2020). What is the proof now? An updated methodological review of research on social stories. *Education and Training in Autism and Developmental Disabilities, 55*(3), 264–276.

Miltenberger, R., Gross, A., Knudson, P., Bosch, A., Jostad, C., & Breitwieser, C. B. (2009). Evaluating behavioral skills training with and without stimulated in situ training for teaching safety skills to children. *Education and Treatment of Children, 32*(1), 63–75.

Miltenberger, R. G., Zerger, H. M., Novotny, M., & Livingston, C. P. (2017). Behavioral skills training to promote social behavior of individuals with autism. In J. B. Leaf (Ed.), *Handbook of social skills and autism spectrum disorder* (pp. 325–342). Springer.

Monlux, K., Pelaez, M., & Holth, P. (2019). Joint attention and social referencing in children with autism: A behavior-analytic approach. *European Journal of Behavior Analysis, 20*(2), 186–203. https://doi.org/10.1080/15021149.2019.1644831

Morris, C., Detrick, J. J., & Peterson, S. M. (2021). Participant assent in behavior analytic research: Considerations for participants with autism and developmental disabilities. *Journal of Applied Behavior Analysis, 54*(4), 1300–1316. https://doi.org/10.1002/jaba.859

Myles, B. S. (2003). Overview of Asperger syndrome. In J. E. Baker (Ed.), *Social skills training for children and adolescents with Asperger Syndrome and social-communication problems* (pp. 9–16). AAPC Publishing.

National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2*. Author.

Neimy, H., Pelaez, M., Carrow, J., Monlux, K., & Tarbox, J. (2017). Infants at risk of autism and developmental disorders: Establishing early social skills. *Behavioral Development Bulletin, 22*(1), 6–22. https://doi.org/10.1037/bdb0000046

Nikopoulos, C. K., & Keenan, M. (2004). Effects of video modeling on social initiations by children with autism. *Journal of Applied Behavior Analysis, 37*(1), 93–96. https://doi.org/10.1901/jaba.2004.37-93

Nuernberger, J. E., Ringdahl, J. E., Vargo, K. K., Crumpecker, A. C., & Gunnarsson, K. F. (2013). Using a behavioral skills training package to teach conversation skills to young adults with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*(2), 411–417. https://doi.org/10.1016/j.rasd.2012.09.004

Odom, S. L., Hoyson, M., Jamieson, B., & Strain, P. S. (1985). Increasing handicapped preschoolers' peer social interactions: Cross-setting and component analysis. *Journal of Applied Behavior Analysis, 18*(1), 3–16. https://doi.org/10.1901/jaba.1985.18-3

Oppenheim-Leaf, M. L., Leaf, J. B., Dozier, C., Sheldon, J. B., & Sherman, J. A. (2012). Teaching typically developing children to promote social play with their siblings with autism. *Research in Autism Spectrum Disorders, 6*(2), 777–791. https://doi.org/10.1016/j.rasd.2011.10.010

Organization for Autism Research. (2018, August 6). *Sex ed*. Organization for Autism Research | Helping Families Today. https://researchautism.org/sex-ed-guide/

Owen-DeSchryver, J. S., Carr, E. G., Cale, S. I., & Blakeley-Smith, A. (2008). Promoting social interactions between students with autism spectrum disorders and their peers in inclusive school settings. *Focus on Autism and Other Developmental Disabilities, 23*, 15–28. https://doi.org/10.1177/1088357608314370

Ozonoff, S., & Miller, J. N. (1995). Teaching theory of mind: A new approach to social skills training for individuals with autism. *Journal of Autism and Developmental Disorders, 25*, 415–433. https://doi.org/10.1007/BF02179376

Palmen, A., Didden, R., & Arts, M. (2008). Improving question asking in high-functioning adolescents with autism spectrum disorders: Effectiveness of small-group training. *Autism, 12*(1), 83–98. https://doi.org/10.1177/1362361307085265

Parenti, K., Weiss, M. J., Nipe, T., & Southwick, J. (2019). *Clinical Corner: Defining and assessing quality of life as an outcome for adults with autism*. Association for Science in Autism Treatment. https://asatonline.org/research-treatment/clinical-corner/quality-of-life/

Parsons, M. B., Bentley, E., Solari, T., & Reid, D. H. (2016). Familiarizing new staff for working with adults with severe disabilities: A case for relationship building. *Behavior Analysis in Practice, 9*(3), 211–222. https://doi.org/10.1007/s40617-016-0129-9

Partington, J. W. (2006). *ABBLS-R: Assessment of basic language and learning, revised*. Behavior Analysts Inc.

Pelaez, M., & Monlux, K. (2018). Development of communication in infants: Implications for stimulus relations research. *Perspectives on Behavior Science, 41*(1), 175–188. https://doi.org/10.1007/s40614-018-0151-z

Pelaez, M., Virues-Ortega, J., & Gewirtz, J. L. (2012). Acquisition of social referencing via discrimination training in infants. *Journal of Applied Behavior Analysis, 45*(1), 23–36. https://doi.org/10.1901/jaba.2012.45-23

Pelaez, M., Borroto, A. R., & Carrow, J. (2018). Infant vocalizations and imitation as a result of adult contingent imitation. *Behavioral Development, 23*(1), 81–88. https://doi.org/10.1037/bdb0000074

Peláez-Nogueras, M., Field, T. M., Hossain, Z., & Pickens, J. (1996). Depressed mothers' touching increases infants' positive affect and attention in still-face interactions. *Child Development, 67*(4), 1780–1792. https://doi.org/10.2307/1131731

Peters, L. C., & Thompson, R. H. (2018). How teaching perspective taking to individuals with autism spectrum disorders affects social skills: Findings from research and suggestions for practitioners. *Behavior Analysis in Practice, 11*(4), 467–478. https://doi.org/10.1007/s40617-018-0207-2

Pollard, J. S., Betz, A. M., & Higbee, T. S. (2012). Script fading to promote unscripted bids for joint attention in children with autism. *Journal of Applied Behavior Analysis, 45*(2), 387–393. https://doi.org/10.1901/jaba.2012.45-387

Radley, K. C., O'Handley, R. D., Ness, E. J., Ford, W. B., Battaglia, A. A., McHugh, M. B., & McLemore, C. E. (2014). Promoting social skill use and generalization in children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 8*(6), 669–680. https://doi.org/10.1016/j.rasd.2014.03.012

Reichow, B., & Volkmar, F. R. (2010). Social skills interventions for individuals with autism: Evaluation for evidence-based practice within a best evidence synthesis framework. *Journal of Autism and Developmental Disorders, 40*(2), 149–166. https://doi.org/10.1007/s10803-009-0842-0

Reynhout, G., & Carter, M. (2006). Social Stories™ for children with disabilities. *Journal of Autism and Developmental Disorders, 36*(4), 445–469. https://doi.org/10.1007/s10803-006-0086-1

Reynhout, G., & Carter, M. (2011). Evaluation of the efficacy of social stories(TM) using three single subject metrics. *Research in Autism Spectrum Disorders, 5*(2), 885–900. https://doi.org/10.1016/j.rasd.2010.10.003

Sala, G., Hooley, M., Attwood, T., Mesibov, G. B., & Stokes, M. A. (2019). Autism and intellectual disability: A systematic review of sexuality and relationship education. *Sexuality and Disability, 37*(3), 353–382. https://doi.org/10.1007/s11195-019-09577-4

Schall, C., Wehman, P., & McDonough, J. L. (2012). Transition from school to work for students with autism spectrum disorders: Understanding the process and achieving better outcomes. *Pediatric Clinics of North America, 59*(1), 189–202. https://doi.org/10.1016/j.pcl.2011.10.009

Schwartz, I. S., & Baer, D. M. (1991). Social validity assessments: Is current practice state of the art? *Journal of Applied Behavior Analysis, 24*(2), 189–204. https://doi.org/10.1901/jaba.1991.24-189

Seaman, R. L., & Cannella-Malone, H. I. (2016). Vocational skills interventions for adults with autism spectrum disorder: A review of the literature. *Journal of Developmental and Physical Disabilities, 28*(3), 479–494. https://doi.org/10.1007/s10882-016-9479-z

Shattuck, P. T., Garfield, T., Roux, A. M., Rast, J. E., Anderson, K., Hassrick, E. M., & Kuo, A. (2020). Services for adults with autism spectrum disorder: A systems perspective. *Current Psychiatry Reports, 22*(3), 13. https://doi.org/10.1007/s11920-020-1136-7

Sherron Targett, P., & Wehman, P. (2009). Integrated employment. In P. Wehman, M. D. Smith, & C. Schall (Eds.), *Autism and the transition to adulthood: Success beyond the classroom* (pp. 163–188). Brookes Pub.

Skinner, B. F. (1957). *Verbal behavior*. Appleton-Century-Crofts.

Smith, T. (2013). What is evidence-based behavior analysis? *The Behavior Analyst, 36*(1), 7–33. https://doi.org/10.1007/BF03392290

Smith, M. D., & Sherron Targett, P. (2009). Integrated employment. In P. Wehman, M. D. Smith, & C. Schall (Eds.), *Autism and the transition to adulthood: Success beyond the classroom* (pp. 233–250). Brookes Pub.

Spain, D., & Blainey, S. H. (2015). Group social skills interventions for adults with high-functioning autism spectrum disorders: A systematic review. *Autism, 19*(7), 874–886. https://doi.org/10.1177/1362361315587659

Sparrow, S. S., Cicchetti, D. V., & Saulnier, C. A. (2016). *Vineland-3: Vineland adaptive behavior scales* (3rd ed.). Pearson.

Sperry, L., Neitzel, J., & Engelhardt-Wells, K. (2010). Peer-mediated instruction and intervention strategies for students with autism spectrum disorders. *Preventing School Failure: Alternative Education for Children and Youth, 54*(4), 256–264. https://doi.org/10.1080/10459881003800529

Spielberger, C. D., Gorsuch, R. L., Lushene, P. R., Vagg, P. R., & Jacobs, A. G. (1983). *Manual for the state-trait anxiety inventory (form Y)*. Mind Garden.

Stein, S., & Dillenburger, K. (2017). Ethics in sexual behavior assessment and support for people with intellectual disability. *International Journal on Disability and Human Development, 16*, 11–17. https://doi.org/10.1515/ijdhd-2016-0023

Stone, W., Ruble, L., Conrod, E., Hepburn, S., Pennington, M., Brunette, C., & Brigham, N. B. (2010). *TRIAD social skills assessment* (2nd ed.). Treatment and Research Institute for Autism Spectrum Disorders.

Styles, A. (2011). Social Stories™: Does the research evidence support the popularity? *Educational Psychology in Practice, 27*(4), 415–436. https://doi.org/10.1080/02667363.2011.624312

Sundberg, M. L. (2008). *VB-MAPP: Verbal behavior milestones assessment and placement program*. AVB Press.

Tanner, A., & Dounavi, K. (2021). The emergence of autism symptoms prior to 18 months of age: A systematic literature review. *Journal of Autism and Developmental Disorders, 51*(3), 973–993. https://doi.org/10.1007/s10803-020-04618-w

Taubman, M., Brierley, S., Wishner, J., Baker, D., McEachin, J., & Leaf, R. B. (2001). The effectiveness of a group discrete trial instructional approach for preschoolers with developmental disabilities. *Research in Developmental Disabilities, 22*(3), 205–219. https://doi.org/10.1016/s0891-4222(01)00068-3

Taubman, M., McEachin, J., & Leaf, R. (2011). *Crafting connections: Contemporary applied behavior analysis for enriching the social lives of persons with autism spectrum disorder*. Different Roads to Learning.

Taylor, B., & Davis, S. (2007). The extended PLISSIT model for addressing the sexual wellbeing of individuals with an acquired disability of chronic illness. *Sexuality and Disability, 25*, 135–139. https://doi.org/10.1007/s11195-007-9044-x

Taylor, B. A., & DeQuinzio, J. A. (2012). Observational learning and children with autism. *Behavior Modification, 36*(3), 341–360. https://doi.org/10.1177/0145445512443981

Thomas, A., & Bambera, L. (2020). Using peer-mediation to enhance conversation and reduce inappropriate communication acts in adolescents with autism. *Education and Training in Autism and Developmental Disabilities, 55*(2), 185–200.

Tiemann, P. W., & Markle, S. M. (1990). *Analyzing instructional content: A guide to instruction and evaluation*. Morningside Press.

Townley-Cochran, D., Leaf, J. B., Taubman, M., Leaf, R., & McEachin, J. (2015). Observational learning for students diagnosed with autism: A review paper. *Review Journal of Autism and Developmental Disorders, 2*, 262–272. https://doi.org/10.1007/s40489-015-0050-0

Travers, J. C., & Schaefer Whitby, P. (2015). Sexuality and relationships for individuals with autism spectrum disorders. In M. Tinacni & A. Bondy (Eds.), *Autism spectrum disorders in adolescents and adults: Evidence-based and promising interventions* (pp. 182–207). Guilford Publications.

United States Department of Health and Human Services. (2018, January). *Ensuring beneficiary health and safety in group homes through state implementation of comprehensive compliance oversight*. https://oig.hhs.gov/reports-and-publications/featured-topics/group-homes/group-homes-joint-report.pdf

van't Hof, M., Tisseur, C., van Berckelear-Onnes, I., van Nieuwenhuyzen, A., Daniels, A. M., Deen, M., Hoek, H. W., & Ester, W. A. (2021). Age at autism spectrum disorder diagnosis: A systematic review and meta-analysis from 2012 to 2019. *Autism: The International Journal of Research and Practice, 25*(4), 862–873. https://doi.org/10.1177/1362361320971107

Veazey, S. E., Valentino, A. L., Low, A. I., McElroy, A. R., & LeBlanc, L. A. (2016). Teaching feminine hygiene skills to young females with autism spectrum disorder and intellectual disabilities. *Behavior Analysis in Practice, 9*(2), 184–189. https://doi.org/10.1007/s40617-015-0065-0

Wang, H. T., & Koyama, T. (2014). An analysis and review of the literature and a three-tier video modeling intervention model. *Research in Autism Spectrum Disorder, 89*(7), 746–758. https://doi.org/10.1016/j.rasd.2014.03.010

Watkins, L., O'Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G. E., Sigafoos, J., & Lang, R. (2015). A review of peer-mediated social interaction interventions for students with autism in inclusive settings. *Journal of Autism and Developmental Disorders, 45*(4), 1070–1083. https://doi.org/10.1007/s10803-014-2264-x

Watkins, L., Ledbetter-Cho, K., O'Reilly, M., Barnard-Brak, L., & Garcia-Grau, P. (2019). Interventions for students with autism in inclusive settings: A best-evidence synthesis and meta-analysis. *Psychological Bulletin, 145*(5), 490–507. https://doi.org/10.1037/bul0000190

Webb, B. J., Miller, S. P., Pierce, T. B., Strawser, S., & Jones, W. P. (2004). Effects of social skill instruction for high-functioning adolescents with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 19*(1), 53–62. https://doi.org/10.1177/10883576040190010701

Wehman, P., Schall, C., Carr, S., Targett, P., West, M. W., & Cifu, G. (2014). Transition from school to adulthood for youth with autism spectrum disorder: What we know and what we need to know. *Journal of Disability Policy Studies, 25*(1), 30–40. https://doi.org/10.1177/1044207313518071

Weingarten, K., & Mechner, F. (1966). The contingency as an independent variable of social interaction. In T. Verhave (Ed.), *The experimental analysis of behavior* (pp. 447–459). Apple-Century-Crofts.

Weisberg, H. R., & Jones, E. A. (2019). Individualizing intervention to teach joint attention, requesting, and social referencing to children with autism. *Behavior Analysis in Practice, 12*(1), 105–123. https://doi.org/10.1007/s40617-018-0265-5

Weiss, M. J., & Harris, S. L. (2001). Teaching social skills to people with autism. *Behavior Modification, 25*(5), 785–802. https://doi.org/10.1177/0145445501255007

Weiss, M. J., Pearson, N., Foley, K., & Pahl, S. (2010). The importance of fluency outcomes in learners with autism. *The Behavior Analyst Today, 11*(4), 245. https://doi.org/10.1037/h0100704

White, S. W., Koenig, K., & Scahill, L. (2007). Social skills development in children with autism spectrum disorders: A review of the intervention research. *Journal of Autism and Developmental Disorders, 37*, 1858–1868. https://doi.org/10.1007/s10803-006-0320-x

Williams, T. I. (1989). A social skills group for autistic children. *Journal of Autism and Developmental Disorders, 19*, 143–155. https://doi.org/10.1007/BF02212726

Winner, M. (2007). *Thinking about you thinking about me* (2nd ed.). Think Social Publishing.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., Brock, M. E., Plavnick, J. B., Fleury, V. P., & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders, 45*(7), 1951–1966. https://doi.org/10.1007/s10803-014-2351-z

World Health Organization. (2012, March 1). *The World Health Organization quality of life (WHOQOL)*. WHO | World Health Organization. https://www.who.int/publications/i/item/WHO-HIS-HSI-Rev.2012.03

Rituals and Stereotypies

12

Jeffrey H. Tiger and Kendall M. Kastner

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What Are Stereotypies and Rituals?

The presence of restricted or repetitive interests, activities, and behaviors represents a core behavioral symptom leading to a diagnosis of an autism spectrum disorder (ASD) based upon the diagnostic and statistical manual of mental disorders (DSM-5) and international classification of diseases (ICD-10). The term "repetitive behavior" commonly includes simple motor movements (e.g., hand flapping, body rocking, facial posturing), repetitive vocalizations (e.g., repeating sounds or phrases emitted by another person or object), ritualistic behaviors (e.g., shutting all the doors in a house, lining up objects), and a general insistence on sameness (e.g., signs of distress associated with deviations from typical schedules). The simple presence of repetitive behaviors is not unique to individuals with autism; such behaviors are commonly present in individuals with intellectual disabilities, schizophrenia, obsessive compulsive disorder, Tourette's disorder, and even among young, typically developing children. The frequency and severity of repetitive behaviors tend to be greater and more debilitating among individuals diagnosed with autism (Smith & Van Houten, 1996; McDougle et al., 1995; Lewis & Kim, 2009).

Repetitive behaviors may emerge even among very young children with autism, the most common of which are motor and vocal stereotypies. Richler et al. (2007) found that the repetitive use

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of objects, unusual sensory interests, complex mannerisms, and hand/finger mannerisms was reported in more than 50% of children with autism as early as age 2. Further, these authors reported that unusual preoccupations and abnormal/idiosyncratic responses to sensory stimuli were reported in over 33% of children with autism at age 2. Both prevalence estimates were significantly different than matched populations of children of typical development or those diagnosed with other developmental disabilities. In addition, parents of children with autism rated the occurrence of these repetitive behaviors to be of greater severity in terms of their disruption of everyday functioning than did parents of matched non-ASD peers.

In describing the phenomenology of stereotypy in 224 children with autism, Campbell et al. (1990) reported that 25% engaged in some form of object stereotypy, 16% engaged in hand flapping, 15% engaged in body rocking, 12% engaged in head tilting, 28% engaged in a stereotypy related to another lower extremity, and 18% engaged in a stereotypy related to another upper extremity. In addition, it has been reported that repetitive self-injurious behavior (SIB) occurs between 6% and 50% of individuals with autism (Akram et al., 2017; Baghdadli et al., 2003; Bartak & Rutter, 1976; Schroeder et al., 1978; Soke et al., 2016).

The simple occurrence of stereotypy and other repetitive behaviors alone is not necessarily problematic, and therefore may not warrant any form of treatment or intervention.[1] However, stereotypy and other repetitive behavior may become problematic when these behaviors limit the extent to which individuals successfully interact with their environment. Specifically, the occurrence of stereotypy during instruction may limit acquisition of academic and social skills (Dunlap et al., 1983; Epstein et al., 1974; Koegel & Covert, 1972; Koegel et al., 1974; Lovaas et al., 1971; Morrison & Rosales-Ruiz, 1997; Risley, 1968). That is, when children engage in stereotypy, they may do so to an extent that competes with their interacting with other individuals and participating in learning activities. Stereotypies and other repetitive behaviors would warrant intervention in such cases with a goal to limit these behaviors to non-disruptive times, but not to eliminate these behaviors entirely.

Given the social and learning challenges engendered by an over-occurrence of stereotypies, a thorough understanding of the conditions responsible for the development of stereotypy and the development of treatments to address stereotypy have remained important areas of research for applied scientists, and in particular, for behavior analysts. This chapter will serve to highlight research that has contributed to our understanding of stereotypies and the development of appropriate treatment approaches.

Why Do Children with Autism Engage in Stereotypies and Rituals?

Although physiology certainly plays a contributory role in the development of stereotypy, behavior-analytic research has focused considerably more attention on the environmental influences that result in stereotypy's development and maintenance. Early investigations with institutionalized populations found the occurrence of stereotypy to be inversely related to the presence of other materials and the amount of social interaction in their environment (Berkson & Mason, 1963, 1965; Davenport & Berkson, 1963) indicating that environmental influences did play an important role. However, it wasn't until after the development of the functional analysis model of behavioral assessment (Hanley et al., 2003; Iwata et al., 1994a, b, c) that the role of environmental consequences in the maintenance of stereotypy and other repetitive problem behaviors could be understood.

Unlike methods of observing correlations between environmental events and repetitive problem behavior, functional analysis methodology involves systematically introducing and removing specified antecedent and consequent events surrounding problem behavior. Through a series of test and control conditions, these assessments demonstrate functional relations between

[1] Self-injurious behavior being a notable exception.

specific variables and the occurrence and non-occurrence of problem behavior (see Beavers et al., 2013 and Hanley et al., 2003 for thorough reviews of these procedures). This methodology was effective at identifying and isolating the specific reinforcers that maintain problem behavior, whether they be social (i.e., consequences delivered by another person such as attention, access to leisure items or food, or escape from non-preferred environments) or non-social (i.e., consequences that are produced directly by the behavior such as visual, auditory, tactile, or vestibular stimulation, pain attenuation, or sensory attenuation; Vollmer, 1994).

Rapp and Vollmer (2005) reviewed the outcomes of published functional analyses of stereotypic behaviors and reported that stereotypy was maintained by non-social sources of reinforcement in more than 90% of published analyses. That is, behaviors such as hand mouthing, hand flapping, and body rocking are rarely maintained by the delivery of attention, tangible items, or escape from non-preferred events, but rather by the direct sensory consequences of the behavior. This contrasts with other forms of problem behavior such as self-injury and aggression, which more commonly are sensitive to social reinforcers (Iwata et al., 1994c).

Although the vast majority of cases of stereotypy are maintained by automatic sources of reinforcement, there have been a few reported instances in which stereotypy has been maintained by social reinforcers as well, so this possibility should not be discounted (Goh et al., 1995; Kennedy et al., 2000). These cases highlight the importance of conducting functional analyses prior to developing treatments for stereotypic behaviors as opposed to making an a priori assumption that the behaviors are maintained by sensory consequences. Treatments based upon an assumption of automatic reinforcement are likely to be ineffective in the subset of cases maintained by social reinforcers (Iwata et al., 1994b). If social reinforcers are found to maintain stereotypy, we recommend implementing interventions that eliminate the social consequence following stereotypy and deliver that consequence either on a fixed-time schedule or following some more desirable communicative response (Carr et al., 2000; Tiger et al., 2008). For the remainder of this chapter, we will focus on the development of function-based interventions for stereotypy maintained by automatic sources of reinforcement.

Querim et al. (2013) offered a modified version of a functional analysis to determine if problem behavior was maintained by social or non-social reinforcers rapidly. Specifically, they conducted a behavioral test for non-social reinforcers during sequential 5-minute sessions in which a target behavior was permitted to occur but did not result in any social consequences. Problem behavior decreasing, or ceasing, under these conditions would indicate the impact of social reinforcers (i.e., problem behavior extinguishes when social reinforcers are withheld). However, problem behavior persisting under these conditions would implicate automatic reinforcement. When compared to the results of a full functional analysis, the outcomes of this brief assessment corresponded in 28 of 30 cases (similar results were reported in a replication by Bell & Fahmie, 2018). Thus, this brief assessment may be an ideal starting point for individuals exhibiting stereotypy to rule in or rule out the role of social consequences rapidly.

Identifying that stereotypies are maintained by non-social reinforcers is typically an initial, but not a final step in the functional assessment process. Identifying maintenance by automatic reinforcement is derived by negating sources of social positive and negative reinforcement but does little to identify what those automatic positive and negative reinforcers for stereotypies may be. This further identification of specific reinforcers will require additional systematic evaluation and testing of informal hypotheses. For example, Goh et al. (1995) identified that self-injurious hand mouthing maintained in the absence of social contingencies and hypothesized that these behaviors likely were reinforced either by stimulation to the hands or to the mouth. These hypotheses were then tested by providing participants with manipulable leisure items. Their predictions were that participants who brought items to their mouth were most likely sensitive to oral reinforcement whereas participants who manipulated items with their hands were most likely sensitive to hand stimulation.

Piazza et al. (1996) provided another example of attempting to isolate specific sources of reinforcement with an individual who engaged in pica with cigarette butts in the absence of any social contingencies. They tested which aspects of the cigarette butts provided reinforcement by conducting a preference assessment in which they presented individual components of the cigarette butt (paper, small amounts of tobacco) as well as an herbal alternative to tobacco. This individual near exclusively consumed tobacco, identifying this component as the essential element needed for automatic reinforcement.

The specification of sources of automatic reinforcement should allow greater precision in selecting effective behavioral intervention models. Specifically, the function-based model of intervention involves disrupting the operant reinforcement contingency thought to maintain problem behavior (Iwata et al., 1990). Identifying the source of operant reinforcement ideally allows clinicians (a) to withhold that consequence to promote extinction of problem behavior and (b) to deliver that reinforcer following a more desirable alternative behavior, for the absence of problem behavior, or simply based upon the passage of time. This approach has shown great success in the treatment of socially maintained problem behavior, but those behaviors maintained by automatic sources of reinforcement require additional consideration. Our discussion will focus upon these components of function-based interventions as applied to automatically maintained problem behavior.

Developing Interventions for Stereotypy and Other Repetitive Behaviors

Eliminating or Attenuating Consequences of Problem Behavior

Extinction has been shown repeatedly to be a critical component of most reinforcement-based interventions for problem behavior. That is, arranging differential reinforcement of alternative behavior (DRA), differential reinforcement of other behavior (DRO), and other forms of behavioral contingencies tends to result in effective treatment only when combined with extinction for problem behavior (e.g., Cowdery et al., 1990; Fisher et al., 1993; Hagopian et al., 1998; Mazaleski et al., 1993; Zarcone et al., 1994). Behavior maintained by automatic reinforcement presents a particular treatment challenge in that the maintaining reinforcer is often inaccessible to a caregiver and may be impossible to withhold entirely. It is relatively easy for a parent to avoid providing their attention following a problem behavior, but more difficult for a parent to withhold the stimulation generated by their child's body rocking.

Rincover et al. (1979) provided one of the earliest systematic demonstrations of the use of sensory extinction to reduce stereotypic behaviors (hand flapping, object spinning, picking, and finger flapping) with four children diagnosed with autism. Initially, the authors formed hypotheses regarding the potential sensory reinforcers which may have maintained these behaviors, such as the sound of the spinning object and the visual stimulation of finger flapping. Next the authors attenuated the sensory consequences of engaging in each behavior (e.g., carpeting the table upon which objects were typically spun resulted in a muffled sound and turning off the lights eliminated visual stimulation). These sensory extinction procedures were found to reduce the occurrence of stereotypy for each of the four participants. In a similar regard, Aiken and Salzberg (1984) eliminated the suspected auditory consequences of loud vocalizations, hand clapping, and dropping items by playing white noise through headphones with two participants. The use of such procedures was eloquent in their experimental demonstration of the effects of sensory extinction, but highly impractical, and ethically questionable, in terms of implementation. (i.e., we would strongly recommend against blindfolding individuals continuously to eliminate hand flapping or to have them continuously experience ambient white noise).

A more common technique for implementing sensory extinction in cases of automatically maintained SIB has been the use of protective equipment to attenuate sensory consequences. For example, Dorsey et al. (1982) disrupted the sensory consequences of head hitting, head banging, and hand biting exhibited by four individuals by having the participants wear a football helmet and padded gloves. Similarly, Mazaleski et al. (1994) reduced the stereotypic hand mouthing of two individuals by placing oven mitts over their hands. Unfortunately, the use of protective equipment may be only somewhat more practical to implement than previously described extinction procedures. The effects of such protective equipment tend to be limited to periods in which the equipment is present; automatically maintained problem behavior frequently returns when protective equipment is removed (e.g., Borrero et al., 2002; Dorsey et al., 1982; Fisher et al., 1997). Thus, protective equipment must be worn for extended periods to reduce automatically maintained self-injury. However, the restriction of problem behavior through protective equipment may restrict other appropriate behaviors (e.g., it can be difficult to manipulate items or to feed oneself with padded gloves or mittens on one's hands) and extended wearing may be associated with muscle atrophy, bone demineralization, and shortening of tendons if the equipment restricts movement (Fisher et al.). Further, most forms of non-injurious repetitive behavior cannot be attenuated through protective equipment. For these reasons, protective equipment is most commonly used for protection from injury associated with SIB rather than as an extinction-based procedure (i.e., without the assumption of long-term reductions in SIB through their usage). We refer interested readers to Fisher et al. (2013) for an extended discussion of the uses of protective equipment during the treatment of problem behavior.

A third technique for implementing sensory extinction has been referred to as response blocking or response interruption (Reid et al., 1993; Lerman & Iwata, 1996; McCord et al., 2005; Smith et al., 1999). For instance, in Reid et al. therapists blocked hand mouthing by placing their hand in front of the participant's mouth. Thus, the participants could engage in the response of lifting their hand towards their mouth, but the sensory experiences from reaching their mouth were disrupted. These forms of extinction procedures do not require specialized equipment but do require the continuous monitoring of the individual. Thus, response blocking may be very costly in terms of the manpower required to implement the procedure with integrity. Very few investigations have evaluated the effects of imperfect implementation of this procedure with some evidence that this treatment is ineffective in isolation (Saini et al., 2016), or that repetitive behavior can worsen (i.e., occur at higher rates) if blocking is implemented intermittently (Lerman & Iwata) or after even a brief delay once stereotypy has begun (Kliebert et al., 2011).

In addition to the practical and ethical limitations of extinction procedures in this context, it is not clear how efficacious extinction procedures will be in treating automatically maintained problem behavior. Withholding access to a particular form of sensory reinforcement will result in a deprivation state from that reinforcer, which may then evoke additional stereotypic behavior under this deprivation state (Rapp, 2006). For instance, if stereotypy was to be disrupted by an extinction procedure during an instructional period, which is then followed by a meal, it is possible that the disruption of stereotypy during the instructional period would result in higher-than-normal levels of stereotypy during the meal period.

Disrupting the occurrence of one form of stereotypy may also increase the occurrence of other forms of stereotypy (Rapp et al., 2004) or more problematic behaviors, such as property destruction and aggression (Fellner et al., 1984; Fisher et al., 1998). Fisher et al. reported two cases of individuals who engaged in property destruction and stereotypic toy play (i.e., tapping in one case and string play in another). When tapping was restricted, one participant broke household items (e.g., lamps) and then engaged in stereotypic tapping with the fragments. Similarly, when the second participant's string play was restricted, she would shred cloth materials (e.g., draperies and clothing) and then engage in string play with the shreds. These more severe destructive behaviors were minimized when more appropriate materials were provided and could be manipulated similarly to the fragments and shreds.

In summation, extinction procedures are never recommended as a sole form of intervention for automatically maintained behavioral concerns. The risks of harm outweigh the potential benefits offered through these procedures. However, extinction procedures may be useful components to more comprehensive intervention attempts.

Developing Alternative Skill Repertoires

Automatically maintained problem behavior can be reduced by allowing similar or alternative sensory experiences via non-problematic behavior. In some instances, this can be achieved by simply providing access to a variety of leisure items (e.g., Berkson & Mason, 1965). Providing access to sensory materials has been described by several terms including non-contingent reinforcement (NCR) and environmental enrichment (Favell et al., 1982; Goh et al., 1995; Horner, 1980; Ringdahl et al., 1997; Rapp, 2007; Roane et al., 2003; Sidener et al., 2005; Vollmer et al., 1994). The success of such interventions is predicated on the extent to which clients engage with the provided materials in lieu of stereotypic behavior, which is not a given.

Vollmer et al. (1994) compared treatment environments enriched with leisure items that were systematically identified to be either preferred or non-preferred by a formal preference assessment with a young boy with severe developmental disabilities who engaged in automatically maintained SIB. Appropriate toy play was high and SIB was low when, and only when, high-preference materials were incorporated into the enriched environment. Preferences among individuals with autism and other developmental disabilities are idiosyncratic in that the events, activities, and materials that serve as powerful reinforcers for one individual may be completely ineffective as reinforcers for another individual. Thus, the identification of individual preferences will contribute to the effectiveness of any reinforcement-based intervention.

Caregiver interview is commonly the first step in determining preferred items. Fisher et al. (1996) provided a useful interview tool termed the Reinforcer Assessment for Individuals with Severe Disabilities, or RAISD, in which caregivers are provided examples of potential reinforcers experienced through different sensory modalities (e.g., visual, auditory, tactile, vestibular, olfactory, and gustatory), are asked to nominate materials or events that are likely enjoyable to the individual, and then to rank order their perceptions of the individuals' preferences for these potential reinforcers. Direct preference assessments can then be conducted with nominated items to establish a preference hierarchy (Cote et al., 2007; Green et al., 1988).

During a direct preference assessment, a potential reinforcer is presented to an individual to determine if they will then approach and manipulate the item (or consume it in the case of edible items). Items may be presented singly (Pace et al., 1985), in pairs (Fisher et al., 1992), or in multiple stimulus arrays (DeLeon & Iwata, 1996). The percentage of trials each item is approached is then rank ordered relative to each other item resulting in a preference hierarchy. Stimuli ranked as highly preferred by these procedures have been found to be more effective when delivered as reinforcers than those stimuli ranked as less preferred.

In addition to ensuring that materials are highly preferred, some have suggested identifying materials that produce stimulation similar to that generated by the repetitive behaviors. For instance, Piazza et al. (1998) compared the effects of two treatments on the occurrence of pica. The authors hypothesized that pica maintained by automatic reinforcement was most likely reinforced by stimulation to the mouth. Their treatment procedures involved providing free access to items that also provided oral stimulation, termed matched stimuli (e.g., food items, teething rings), or other items that were identified as highly preferred, but did not provide oral stimulation (e.g., swings, fans, mirrors). Matched-stimulation items resulted in substantial reductions in pica relative to those that were preferred but did not provide similar forms of stimulation (for a similar evaluation see Piazza et al., 2000a).

In order to efficiently identify specific matched and non-matched stimuli to compete with the occurrence of problem behavior, some have recommend conducting a brief competing items assessment (Fisher et al., 2000, 2004; Hagopian et al., 2020; Jennett et al., 2011; Leif et al., 2020; Piazza et al., 1998; Schmidt et al., 2021; Shore et al., 1997; Groskreutz et al., 2011) in which the durations of item engagement and problem behavior are measured in the presence of each item individually during brief sessions (e.g., 5 minutes). Those items that fail to compete with stereotypy during a brief assessment can be eliminated from further consideration and those that effectively compete with stereotypy may be included in further intervention programming. Ideally, multiple potential competing items would be identified and incorporated into enriched environments to minimize satiation effects (Lindberg et al., 2003).

Despite the inclusion of high quality, competing sources of reinforcement, some individuals will continue to engage in high rates of stereotypy and low rates of item engagement (e.g., Favell et al., 1982). There are a number of potential explanations for this finding. Individuals may simply not have a history of reinforcement for interacting with particular items. Therefore, it may be useful to include periodic prompts to engage with materials (Hanley et al., 2000; Lerman et al., 2003). For instance, Lerman et al. reported a case of a young girl with autism that engaged in head and tooth tapping. During one of their analyses, a treatment condition was introduced in which tapping was blocked and a variety of high preference leisure items were delivered. However, item interaction remained low until the experimenters prompted item interaction by physically guiding the participant to manipulate the items every 20 s if she was not doing so independently.

Other individuals may not have the skill repertoire necessary to extract reinforcement from the provided items. Additional skill training or modification of the environment will be necessary to improve the effectiveness of enriched environments. For instance, Vollmer et al. (1994) reported two cases in which an enriched environment was arranged with preferred items that required activation to operate (e.g., sound-making toys). This treatment was initially ineffective because the toys were difficult to operate. Stereotypy was reduced only when the therapists activated the preferred materials for the participants following a simple reaching response. To achieve a greater degree of independence, one of the sound-making toys was connected to a large microswitch that could be operated independently by their participant and low levels of stereotypy were maintained.

It is worth considering the effort required to engage in a newly taught skill relative to stereotypy. It may be possible, in at least some instances, to decrease the effort required to engage in a more socially appropriate behavior so it is more likely to compete with stereotypy. Piazza et al. (2000b) described the case of a boy with profound developmental disability and cortical blindness who engaged in pica and hand mouthing. Their initial treatment condition involved providing access to toys that were more appropriate for mouthing; however, this treatment occasioned high levels of pica and hand mouthing because the participant would frequently drop his toys and was unable to locate them. The effort associated with relocating his toys was then minimized by attaching each item to a vest he wore via strings. He was taught to use the strings to retrieve the toys when they were dropped. This manipulation resulted in consistently low levels of pica and hand mouthing and high levels of more appropriate object mouthing.

It may also be possible to increase the effort associated with stereotypy, and thereby decrease its occurrence. Increasing the response effort of stereotypy has generally been accomplished by adding physical resistance to the limb or limbs associated with stereotypy without completely immobilizing the limb. For instance, Hanley et al. (1998) increased the effort associated with automatically maintained head hitting by placing wrist weights on the participants arms, resulting in a 92% reduction in head hitting relative to baseline conditions without the weights. Further, these wrist weights did not compete with other adaptive behaviors that were measured (specifically self-feeding and pacifier-to-mouth play) and were associated with the development of novel communicative behavior.

Zhou et al. (2000) provided an additional demonstration of the effects of increasing the response effort required to engage in stereotypy with four adults who engaged in hand mouthing. The effort associated with hand mouthing was increased by placing the participants in soft flexible sleeves that increased resistance for bending at the elbow, but still allowed hand mouthing to occur. Like the results of Hanley et al. (1998), these authors found that increasing the effort associated with stereotypy decreased the occurrence of this behavior and increased the occurrence of other appropriate object manipulation.

For some individuals, it may be necessary to arrange differential reinforcement contingencies to promote and strengthen object manipulation. For instance, in Vollmer et al. (1994) stereotypy rates remained high and no object manipulation was observed during an environmental enrichment condition. However, when each instance of object manipulation resulted in a 2-s drink from a bottle of juice, object manipulation increased well above levels of stereotypy. The effectiveness of a differential-reinforcement based treatment relies on the identification of a reinforcer that may be delivered repeatedly and whose value will remain greater than that of stereotypy.

Reinforcement for the Non-occurrence of Stereotypy

Differential reinforcement of the non-occurrence of stereotypy (DRO) involves providing high-quality reinforcers contingent upon periods of time in which an individual abstains from stereotypy (Cowdery et al., 1990; Fellner et al., 1984; Foxx & Azrin, 1973; Repp et al., 1974; Taylor et al., 2005). Cowdery et al. provided one example of a DRO procedure with a 9-year-old boy who engaged in severe, stereotypic self-scratching and self-rubbing. This procedure involved delivering pennies (conditioned reinforcers) that were exchangeable for a variety of back-up reinforcers (e.g., TV, snacks, video games, other play materials) contingent upon periods of time in which the participant abstained from self-scratching. Initially this DRO interval was set for 2 minutes and was gradually expanded to 30 minutes as the treatment proved successful.

Similar to NCR, the first step in arranging a DRO-based intervention is to identify highly preferred stimuli that may be delivered as reinforcers. After these have been identified, the next step is to determine initial durations of the DRO interval (i.e., how long need the individual abstain from stereotypy prior to delivering reinforcement). If the DRO interval is set too short (i.e., reinforcement is delivered frequently) it is likely that satiation will set in, and the treatment will lose its effectiveness. If the DRO interval is set to long, it is possible that such an omission criterion will not be met, and thus behavior will not contact the reinforcement contingency. For these reasons, DRO intervals are best set idiosyncratically, based upon each individual's presenting level of problem behavior. Vollmer et al. (1993) described a process for setting their DRO intervals by first collecting baseline data on the occurrence of problem behavior, and from this data, calculating the mean inter-response interval (IRI), or the time between each response cluster. That is, if an individual engaged in problem behavior at a rate of 6 per minute, there would be a mean of 10-s between each response, and thus their initial DRO interval would be set to 10-s. Interestingly, Vollmer et al. continued to adjust their DRO equivalent to the previous sessions' IRI's such that the DRO interval continued to adjust upward as their procedure was effective at lowering problem behavior. Adjusting DRO intervals over time will decrease the overall number of reinforcers delivered, and thus minimize long-term reinforcer satiation.

It is also important to decide whether DRO intervals will reset immediately or not reset following the occurrence of problem behavior.

During a resetting DRO, each instance of problem behavior will immediately restart the DRO interval (e.g., another 10-s would need to elapse without problem behavior), thus there is a constant response-reinforcer interval (Vollmer & Iwata, 1992). During a non-resetting DRO, reinforcement is programmed to occur at specific time intervals, and the occurrence of problem behavior prior to the elapse of that time interval simply causes the omission of that reinforcer. In this regard, the response-reinforcer interval may vary depending upon the time during which problem behavior occurs. We are not aware of any comparative studies to suggest that either resetting or non-resetting DRO intervals are superior, but both have been independently shown to be effective (Repp et al., 1974, 1976).

One of the challenges associated with implementing either resetting or non-resetting DRO procedures is that they require the constant monitoring of the occurrence or non-occurrence of problem behavior to determine if reinforcement should be delivered, and thus may not be practically implemented in many typical care settings. Momentary DRO procedures may provide an alternative that may be substantially easier to implement with fidelity. For instance, after determining the self-injurious scratching of a young boy with autism to be maintained by automatic sources of reinforcement, Toussaint and Tiger (2012) described the use of a momentary DRO procedure in which rather than observing problem behavior for the entire duration of an interval, a therapist noted the occurrence or non-occurrence of problem behavior at the instant an interval ended and delivered reinforcement only if behavior was not occurring at that instant. Although numerous problem behaviors could occur without postponing the delivery of reinforcement, this momentary procedure was effective at reducing self-scratching as the duration of omission intervals were extended to 5 minutes. This study included a single participant, so the generality of these outcomes is unknown and requires further investigation.

Punishment

Despite the most extraordinary efforts of the most trained clinicians, some cases will remain for which a reinforcer of sufficient strength to compete with stereotypy cannot be identified, and extinction procedures cannot be successfully implemented. In these cases, a practitioner is limited to two options. The first is to cease the treatment of stereotypy. The negative impact of stereotypy and the challenges it imposes upon the life of the individual should be weighed against the cost of continued intervention. It is important for clinicians to balance the intrusiveness of their intervention with the importance of behavior change for their client. Clinicians should implement punishment-based procedures only in cases in which the occurrence of stereotypy is debilitating or detracts from the individual's quality of life (Van Houten et al., 1988).

The early stereotypy treatment literature is replete with examples of the use of highly intrusive forms of punishment such as electric shock (Baumeister & Forehand, 1972; Risley, 1968), slapping (Foxx & Azrin, 1973; Koegel et al., 1974), aversive tastes (Foxx & Azrin, 1973; Friman et al., 1984), aversive odors (Clarke & Thomason, 1983), and water misting (Friman et al.). However, research has also shown the effectiveness of more benign forms of punishment such as verbal reprimands (Baumeister & Forehand, 1972; Foxx & Azrin, 1973; McKenzie et al., 2008), overcorrection (Doke & Epstein, 1975; Epstein et al., 1974; Foxx & Azrin, 1973; Harris & Wolchik, 1979; Maag et al., 1986; Ollendick et al., 1978) time-out and response-cost procedures (Falcomata et al., 2004; Pendergrass, 1972; Watkins & Rapp, 2014).

It is important to recognize that the contingent delivery of any social consequence following the occurrence of a problem behavior may inadvertently serve as a reinforcer and make problem behaviors more frequent. Assessments that can predict which consequences are likely to serve as reinforcers and punishers would be of great clinical value.

Fisher et al. (1994a, b) described a process for identifying potential punishers (as part of a larger assessment for both preferred and aversive consequences). This assessment involved (a) identifying potential punishers from the published literature, (b) soliciting nominations from caregivers as to which procedures would be socially acceptable, and (c) presenting those nominated events on a fixed time schedule during individual sessions. During these presentation sessions, the potential aversive event was presented, and the researchers recorded measures of affect, such as positive and negative vocalizations, as well as measures of approach and avoidance. Those stimuli found to occasion avoidant behavior and signs of negative affect served as effective punishers during subsequent treatment evaluations whereas those associated with approach behaviors and signs of positive affect were less effective at reducing problem behavior.

Verriden and Roscoe (2019) provided another model of punisher evaluation with four individuals with ASD who engaged in automatically maintained problem behavior. This evaluation similarly progressed through the nomination of socially acceptable punishers, this time by client's clinical staff, but involved the evaluation of each potential punisher during a multi-element comparison. That is, each potential punisher was delivered contingent upon the occurrence of problem behavior during an individual session and reductions in problem behavior were evaluated across each condition to determine consistent reductions. Consequences shown to serve as punishers without eliciting emotional responses were then evaluated individually and were found to maintain low levels of problem behavior.

The decision to implement punishment contingencies for stereotypy should not be taken lightly, particularly in cases in which the occurrence of stereotypy is non-injurious and non-life threatening. The clinical decision-making process for when such procedures are and are not appropriate is beyond the scope of this chapter and should be made in consultation with caregivers and clients and in accord with state and federal law, along with the ethical code for behavior analytic practice. When a decision that punishment procedures are warranted has been made, we refer readers to Lerman and Vorndran (2002) for a comprehensive coverage of factors leading to the efficacy of such interventions.

Selecting Among Treatment Options

The approach to selecting treatment options following a functional analysis has frequently progressed using a least-to-most intrusive intervention model. That is, NCR and Differential Reinforcement based interventions may be attempted first with more intrusive components such as blocking or punishment introduced later if necessary (Rooker et al., 2018). However, recent work may offer additional guidance in treatment selection. Hagopian et al. (2015) suggested an additional taxonomy of automatically maintained self-injurious behavior based upon behavioral patterns observed during functional analyses. Specifically, these authors suggested that automatically maintained SIB could be broken into subtypes based upon the level of response differentiation observed between the test condition for automatic reinforcement (typically an alone condition) and the control or play condition. Individuals who exhibited high levels of automatically maintained SIB during the test condition and low levels of SIB in the control condition were categorized into subtype I, and individuals with high levels of SIB across both test and control conditions were categorized into subtype II. The importance of this subtyping came in predicting responses to intervention. Individuals displaying patterns consistent with subtype I tended to respond to interventions based upon non-contingent and differential reinforcement (i.e., less intrusive interventions) whereas individuals in subtype II were characteristically non-responders to these same interventions and were most likely to require punishment-based interventions to result in reductions in SIB (see also Hagopian et al., 2017, 2018).

Virues-Ortega et al. (2022) offered another subtyping model based upon disruptions in automatically maintained problem behavior during other test conditions of a functional analysis. Specifically, these authors identified if the lowest levels of problem behavior occurred during escape conditions (which may suggest that providing alternative activities, attention or task demands may disrupt these behaviors) or if the lowest levels of problem behavior occurred during attention conditions (which may suggest that providing alternative leisure items or issuing mild reprimands following problem behavior may serve as an effective treatment). These authors identified that each of these patterns could be found in review of the published literature, but it is unclear as of yet if such subtyping models will improve the predictive utility of functional analyses in prescribing behavioral interventions for automatically maintained problem behavior. However, such developments will be important advances for our field and our ability to treat these behavioral challenges effectively and efficiently.

Clinicians will need to be thoughtful about whether repetitive behavior should be targeted for global reductions or whether there are times in which repetitive behaviors would be nonproblematic. Injurious or destructive behaviors will likely need to be reduced across all environments, but other repetitive behaviors such as body rocking or hand flapping may only be problematic when disrupting educational opportunities. In these latter cases, we recommend teaching clients to discriminate between when these behaviors are and are not appropriate (i.e., to develop stimulus control over the occurrence of the stereotypic response; Falcomata et al., 2007; Piazza et al., 1996; Rollings & Baumeister, 1981; Tiger et al., 2017). Tiger et al. used such an approach with a young boy with autism who engaged in repetitive sock-flapping. These experimenters arranged conditions in which the client wore a bracelet (S+) when sock flapping was permitted, and the therapist wore the bracelet (S−) when sock-flapping would be disrupted. The authors found sock flapping attempts reduced to zero levels when presented with the S− but maintained client access to this reinforcing behavior when presented with the S+. These S− periods created opportunities to teach new skills, without entirely denying access to the sensory consequences of stereotypy.

Some researchers have specifically arranged access to stereotypy as a reinforcer for engaging in other important activities in a chained-reinforcement schedule (Charlop et al., 1990; Hanley et al., 2000; Hung, 1978; Wolery et al., 1985). This would involve (a) blocking or otherwise restricting access to stereotypy and (b) providing access to stereotypy following the occurrence of some desirable behavior. Hung (1978) restricted access to stereotypy with two withdrawn adolescents with autism enrolled in a summer camp and delivered tokens exchangeable for access to brief periods in which to engage in stereotypy contingent upon appropriate utterances. Appropriate vocalizations increased for both participants. Potter et al. (2013) used a similar approach to increase the toy play of three adolescents diagnosed with autism by blocking stereotypy prior to completing a requisite of engagement. This study was notable for initially targeting simple engagement (i.e., contact with toys) and then progressively increasing the frequency and complexity of responses (e.g., building houses out of blocks) before delivering reinforcement.

Conclusions and Recommendations

Stereotypy, rituals, and other repetitive behaviors are one of the core behavioral symptoms leading to a diagnosis of autism. Although the topography of these behaviors varies from individual to individual, these behaviors often share the same functional properties in that they tend to be maintained by automatic sources of reinforcement, with important exceptions. There have been demonstrations and replications of several operant-based interventions in the behavior analytic literature that involve eliminating or attenuating the sensory consequences of the behavior, providing matched or competing forms of stimulation to substitute for the sensory consequences of stereotypy, delivering alternative forms of reinforcement for appropriate behavior or for the non-occurrence of stereotypy, and arranging punishers to follow the occurrence of stereotypy. We encourage practitioners to remain mindful of the preferences and humanity of their clients in determining whether stereotypic behaviors necessitate intervention, and whether the nature of that intervention should be to eliminate those behaviors or simply to teach appropriate timing of when such behaviors can occur. To the greatest extent possible, we believe clients themselves should be permitted to participate in such treatment decisions as well as their caregivers, teachers, and other important decision makers. We also call on our researchers to assess the social validity of interventions for stereotypy more directly with the clients that experience these interventions, as well as their outcomes (Hanley, 2010).

References

Aiken, J. M., & Salzberg, C. L. (1984). The effects of a sensory extinction procedure on stereotypic sounds of two autistic children. *Journal of Autism and Developmental Disorders, 14*, 291–299. https://doi.org/10.1007/BF02409580

Akram, B., Batool, M., Rafi, Z., & Akram, A. (2017). Prevalence and predictors of non-suicidal self-injury among children with autism spectrum disorder. *Pakistan Journal of Medical Sciences, 33*(5), 1225–1229. https://doi.org/10.12669/pjms.335.12931

Baghdadli, A., Pascal, C., Grisi, S., & Aussilloux, C. (2003). Risk factors for self-injurious behaviors among 222 young children with autistic disorders. *Journal of Intellectual Disability Research, 47*(8), 622–627. https://doi.org/10.1046/j.1365-2788.2003.00507.x

Bartak, L., & Rutter, M. (1976). Differences between mentally retarded and normally intelligent autistic children. *Journal of Autism and Child Schizophrenia, 6*, 109–120. https://doi.org/10.1007/BF01538054

Baumeister, A. A., & Forehand, R. (1972). Effects of contingent shock and verbal command on body rocking of retardates. *Journal of Clinical Psychology, 28*, 586–590. https://doi.org/10.1002/1097-4679(197210)28:4<586::AID-JCLP2270280442>3.0.CO;2-8

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 1–21. https://doi.org/10.1002/jaba.30

Bell, M. C., & Fahmie, T. A. (2018). Functional analysis screening for multiple topographies of problem behavior. *Journal of Applied Behavior Analysis, 51*(3), 528–537. https://doi.org/10.1002/jaba.462

Berkson, G., & Mason, W. A. (1963). Stereotyped movements of mental defectives: III. Situation effects. *American Journal of Mental Deficiency, 68*, 409–412.

Berkson, G., & Mason, W. A. (1965). Stereotyped movements of mental defectives. IV. The effects of toys and the character of the acts. *American Journal of Mental Deficiency, 70*, 511–524.

Borrero, J. C., Vollmer, T. R., Wright, C. S., Lerman, D. C., & Kelley, M. E. (2002). Further evaluation of the role of protective equipment in the functional analysis of self-injurious behavior. *Journal of Applied Behavior Analysis, 35*(1), 69–72. https://doi.org/10.1901/jaba.2002.35-69

Campbell, M., Locascio, J. J., Choroco, M. C., Spencer, E. K., Malone, R. P., Kafantaris, V., et al. (1990). Stereotypies and Tardive Dyskinesia: Abnormal movements in autistic children. *Psychopharmacology Bulletin, 26*, 260–266.

Carr, J. E., Coriarty, S., Wilder, D. A., Gaunt, B. T., Dozier, C. L., Britton, L. N., et al. (2000). A review of "noncontingent" reinforcement as treatment for aberrant behavior of individuals with developmental disabilities. *Research in Developmental Disabilities, 21*(5), 377–391. https://doi.org/10.1016/S0891-4222(00)00050-0

Charlop, M. H., Kurtz, P. F., & Casey, F. G. (1990). Using aberrant behaviors as reinforcers for autistic children. *Journal of Applied Behavior Analysis, 23*(2), 163–181. https://doi.org/10.1901/jaba.1990.23-163

Clarke, J. C., & Thomason, S. (1983). The use of an aversive smell to eliminate autistic self-stimulatory behavior. *Child and Family Behavior Therapy, 5*(3), 51–61. https://doi.org/10.1300/J019v05n03_04

Cote, C. A., Thompson, R. H., Hanley, G. P., & McKerchar, P. M. (2007). Teacher report and direct assessment of preferences for identifying reinforcers for young children. *Journal of Applied Behavior Analysis, 40*(1), 157–166. https://doi.org/10.1901/jaba.2007.177-05

Cowdery, G. E., Iwata, B. A., & Pace, G. M. (1990). Effects and side effects of DRO as treatment for self-injurious behavior. *Journal of Applied Behavior Analysis, 23*(4), 497–506. https://doi.org/10.1901/jaba.1990.23-497

Davenport, R. K., & Berkson, G. (1963). Stereotyped movements of mental defectives: II. Effects of novel objects. *American Journal of Mental Deficiency, 67*, 879–882.

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*(4), 519–533. https://doi.org/10.1901/jaba.1996.29-519

Doke, L. A., & Epstein, L. H. (1975). Oral overcorrection: Side effects and extended applications. *Journal of Experimental Child Psychology, 20*, 496–511.

Dorsey, M. F., Iwata, B. A., Reid, D. H., & Davis, P. A. (1982). Protective equipment: Continuous and contingent application in the treatment of self-injurious behavior. *Journal of Applied Behavior Analysis, 15*(2), 217–230. https://doi.org/10.1901/jaba.1982.15-217

Dunlap, G., Dyer, K., & Koegel, R. L. (1983). Autistic self-stimulation and intertrial interval duration. *American Journal of Mental Deficiency, 88*, 914–202.

Epstein, L. H., Doke, L. A., Sajwaj, T. E., Sorrell, S., & Rimmer, B. (1974). Generality and the side effects of overcorrection. *Journal of Applied Behavior Analysis, 7*(3), 385–390. https://doi.org/10.1901/jaba.1974.7-385

Falcomata, T. S., Roane, H. S., Hovanetz, A. N., Kettering, T. L., & Kenney, K. M. (2004). An evaluation of response cost in the treatment of inappropriate vocalizations maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 37*(1), 83–87. https://doi.org/10.1901/jaba.2004.37-83

Falcomata, T. S., Roane, H. S., & Pabico, R. R. (2007). Unintentional stimulus control during the treatment of pica displayed by a young man with autism. *Research in Autism Spectrum Disorders, 1*(4), 350–359. https://doi.org/10.1016/j.rasd.2006.12.004

Favell, J. E., McGimsey, J. F., & Schell, R. M. (1982). Treatment of self-injury by providing alternate sensory activities. *Analysis and Interventions in Developmental Disabilities, 2*(1), 83–104. https://doi.org/10.1016/0270-4684(82)90007-6

Fellner, D. J., LaRoche, M., & Sulzer-Azaroff, B. (1984). The effects of adding interruption to differential reinforcement on targeted and novel self-stimulatory behaviors. *Journal of Behavior Therapy and Experimental Psychiatry, 15*(4), 315–321. https://doi.org/10.1016/0005-7916(84)90095-8

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*(2), 491–498. https://doi.org/10.1901/jaba.1992.25-491

Fisher, W. W., Piazza, C. C., Cataldo, M., Harrell, R., Jefferson, G., & Conner, R. (1993). Functional communication training with and without extinction and punishment. *Journal of Applied Behavior Analysis, 26*(1), 23–35. https://doi.org/10.1901/jaba.1993.26-23

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., & Langdon, N. A. (1994a). Empirically derived consequences: A data-based method for prescribing treatments for destructive behavior. *Research in Developmental Disabilities, 15*(2), 133–149. https://doi.org/10.1016/0891-4222(94)90018-3

Fisher, W. W., Piazza, C. C., Bowman, L. G., Kurtz, P. F., Sherer, M. R., & Lachman, S. R. (1994b). A preliminary evaluation of empirically derived consequences for the treatment of pica. *Journal of Applied Behavior Analysis, 27*(3), 447–457. https://doi.org/10.1901/jaba.1994.27-447

Fisher, W. W., Piazza, C. C., Bowman, L. G., & Amari, A. (1996). Integrating caregiver report with a systematic choice assessment to enhance reinforcer identification. *American Journal on Mental Retardation, 101*, 15–25.

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hanley, G. P., & Adelinis, J. D. (1997). Direct and collateral effects of restraints and restraint fading. *Journal of Applied Behavior Analysis, 30*(1), 105–120. https://doi.org/10.1901/jaba.1997.30-105

Fisher, W. W., Lindauer, S. E., Alterson, C. J., & Thompson, R. H. (1998). Assessment and treatment of destructive behavior maintained by stereotypic object manipulation. *Journal of Applied Behavior Analysis, 31*(4), 513–527. https://doi.org/10.1901/jaba.1998.31-513

Fisher, W. W., O'Conner, J. T., Kurtz, P. F., DeLeon, I. G., & Gotjen, D. L. (2000). The effects of noncontingent delivery of high- and low-preference stimuli on attention-maintained destructive behavior. *Journal of Applied Behavior Analysis, 33*(1), 79–83. https://doi.org/10.1901/jaba.2000.33-79

Fisher, W. W., DeLeon, I. G., Rodriguez-Catter, V., & Keeney, K. M. (2004). Enhancing the effects of extinction of attention-maintained behavior through noncontingent delivery of attention or stimuli identified via a competing items assessment. *Journal of Applied Behavior Analysis, 37*(2), 171–184. https://doi.org/10.1901/jaba.2004.37-171

Fisher, W. W., Rodriguez, N. M., Luczynski, K. C., & Kelley, M. E. (2013). The use of protective equipment in the management of severe behavior disorders. In D. Reed, F. DiGennaro Reed, & J. Luiselli (Eds.), *Handbook of crisis intervention and development disabilities. Issues in clinical child psychology*. Springer. https://doi.org/10.1007/978-1-4614-6531-7_6

Foxx, R. M., & Azrin, N. H. (1973). The elimination of autistic self-stimulatory behavior by overcorrection. *Journal of Applied Behavior Analysis, 6*(1), 1–14. https://doi.org/10.1901/jaba.1973.6-1

Friman, P. C., Cook, J. W., & Finney, J. W. (1984). Effects of punishment procedures on the self-stimulatory behavior of an autistic child. *Analysis and Interventions in Developmental Disabilities, 4*(1), 39–46. https://doi.org/10.1016/0270-4684(84)90017-X

Goh, H., Iwata, B. A., Shore, B. A., DeLeon, I. G., Lerman, D. C., Ulrich, S. M., et al. (1995). An analysis of the reinforcing properties of hand mouthing. *Journal of Applied Behavior Analysis, 28*(3), 269–283. https://doi.org/10.1901/jaba.1995.28-269

Green, C. W., Reid, D. H., White, L. K., Halford, R. C., Brittain, D. P., & Gardner, S. M. (1988). Identifying reinforcers for persons with profound handicaps: Staff opinion versus systematic assessment of preferences. *Journal of Applied Behavior Analysis, 21*(1), 31–43. https://doi.org/10.1901/jaba.1988.21-31

Groskreutz, M. P., Groskreutz, N. C., & Higbee, T. S. (2011). Response competition and stimulus preference in the treatment of automatically reinforced behavior: A comparison. *Journal of Applied Behavior Analysis, 44*(1), 211–215. https://doi.org/10.1901/jaba.2011.44-211

Hagopian, L. P., Fisher, W. W., Thibault Sullivan, M., Acquisto, J., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*(2), 211–235. https://doi.org/10.1901/jaba.1998.31-211

Hagopian, L. P., Rooker, G. W., & Zarcone, J. R. (2015). Delineating subtypes of self-injurious behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 48*(3), 523–543. https://doi.org/10.1002/jaba.236

Hagopian, L. P., Rooker, G. W., Zarcone, J. R., Bonner, A. C., & Arevalo, A. R. (2017). Further analysis of subtypes of automatically reinforced SIB: A replication and quantitative analysis of published data sets. *Journal of Applied Behavior Analysis, 50*(1), 48–66. https://doi.org/10.1002/jaba.368

Hagopian, L. P., Rooker, G. W., & Yenokyan, G. (2018). Identifying predictive behavioral markers: A demonstration using automatically reinforced self-injurious behavior. *Journal of Applied Behavior Analysis, 51*(3), 443–465. https://doi.org/10.1002/jaba.477

Hagopian, L. P., Frank-Crawford, M. A., Javed, N., Fisher, A. B., Dillion, C. M., Zarcone, J. R., & Rooker, G. W. (2020). Initial outcomes of an augmented competing stimulus assessment. *Journal of Applied Behavior Analysis, 53*(4), 2172–2185. https://doi.org/10.1002/jaba.725

Hanley, G. P. (2010). Toward effective and preferred programming: A case for the objective measurement of social validity with recipients of behavior change-programs. *Behavior Analysis in Practice, 3*, 13–21. https://doi.org/10.1007/BF03391754

Hanley, G. P., Piazza, C. C., Keeney, K. M., Blakely-Smith, A., & Worsdell, A. S. (1998). Effects of wrist weights on self-injurious and adaptive behaviors. *Journal of Applied Behavior Analysis, 31*(2), 307–310. https://doi.org/10.1901/jaba.1998.31-307

Hanley, G. P., Iwata, B. A., Thompson, R. H., & Lindberg, J. S. (2000). A component analysis of "stereotypy as reinforcement" for alternative behavior. *Journal of Applied Behavior Analysis, 33*(3), 285–297. https://doi.org/10.1901/jaba.2000.33-285

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36*(2), 147–185. https://doi.org/10.1901/jaba.2003.36-147

Harris, S. L., & Wolchik, S. A. (1979). Suppression of self-stimulation: Three alternative strategies. *Journal of Applied Behavior Analysis, 12*(2), 185–198. https://doi.org/10.1901/jaba.1979.12-185

Horner, R. D. (1980). The effects of an environmental "enrichment" program on the behavior of institutionalized profoundly retarded children. *Journal of Applied Behavior Analysis, 13*(3), 473–491. https://doi.org/10.1901/jaba.1980.13-473

Hung, D. W. (1978). Using self-stimulation as reinforcement for autistic children. *Journal of Autism and Childhood Schizophrenia, 8*, 355–366. https://doi.org/10.1007/BF01539637

Iwata, B. A., Vollmer, T. R., & Zarcone, J. R. (1990). The experimental (functional) analysis of behavior disorders: Methodology, applications, and limitations. In A. C. Repp & N. N. Singh (Eds.), *Perspectives on the use of nonaversive and aversive interventions for persons with developmental disabilities* (pp. 301–330). Sycamore Publishing Company.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994a). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. Reprinted from Analysis and Intervention in Developmental Disabilities, 2, 3–20, 1982. https://doi.org/10.1901/jaba.1994.27-197

Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994b). What makes extinction work: An analysis of procedural form and function. *Journal of Applied Behavior Analysis, 27*(1), 131–144. https://doi.org/10.1901/jaba.1994.27-131

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., et al. (1994c). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27*(2), 215–240. https://doi.org/10.1901/jaba.1994.27-215

Jennett, H., Jann, K., & Hagopian, L. P. (2011). Evaluation of response blocking and representation in a competing stimulus assessment. *Journal of Applied Behavior Analysis, 44*(4), 925–929. https://doi.org/10.1901/jaba.2011.44-925

Kennedy, C. H., Meyer, K. A., Knowles, T., & Shukla, S. (2000). Analyzing the multiple functions of stereotypical behavior for students with autism: Implications for assessment and treatment. *Journal of Applied Behavior Analysis, 33*(4), 559–571. https://doi.org/10.1901/jaba.2000.33-559

Kliebert, M. L., Tiger, J. H., & Toussaint, K. A. (2011). An approach to identify the conditions under which response interruption will reduce automatically reinforced problem behavior. *Behavior Analysis in Practice, 4*(1), 17–26. https://doi.org/10.1007/BF03391771

Koegel, R. L., & Covert, A. (1972). The relationship of self-stimulation to learning in autistic children. *Journal of Applied Behavior Analysis, 5*(4), 381–387. https://doi.org/10.1901/jaba.1972.5-381

Koegel, R. L., Firestone, P. B., Kramme, K. W., & Dunlap, G. (1974). Increasing spontaneous play by suppressing self-stimulation in autistic children. *Journal of Applied Behavior Analysis, 7*(4), 521–528. https://doi.org/10.1901/jaba.1974.7-521

Leif, E. S., Roscoe, E. M., Ahearn, W. H., Rogalski, J. P., & Morrison, H. (2020). Increasing item engagement and decreasing automatically reinforced problem behavior with a modified competing stimulus assessment. *Journal of Applied Behavior Analysis, 53*(3), 1638–1659. https://doi.org/10.1002/jaba.695

Lerman, D. C., & Iwata, B. A. (1996). A methodology for distinguishing between extinction and punishment effects associated with response blocking. *Journal of Applied Behavior Analysis, 29*(2), 231–233. https://doi.org/10.1901/jaba.1996.29-231

Lerman, D. C., & Vorndran, C. M. (2002). On the status of knowledge for using punishment: Implications for treating behavior disorders. *Journal of Applied Behavior Analysis, 35*(4), 431–464. https://doi.org/10.1901/jaba.2002.35-431

Lerman, D. C., Kelley, M. E., Vorndran, C. M., & Van Camp, C. M. (2003). Collateral effects of response blocking during the treatment of stereotypic behavior. *Journal of Applied Behavior Analysis, 36*(1), 119–123. https://doi.org/10.1901/jaba.2003.36-119

Lewis, M., & Kim, S. J. (2009). The pathophysiology of restricted repetitive behavior. *Journal of Neurodevelopmental Disorders, 1*, 114–132. https://doi.org/10.1007/s11689-009-9019-6

Lindberg, J. S., Iwata, B. A., Roscoe, E. M., Worsdell, A. S., & Hanley, G. P. (2003). Treatment efficacy of noncontingent reinforcement during brief and extended application. *Journal of Applied Behavior Analysis, 36*(1), 1–19. https://doi.org/10.1901/jaba.2003.36-1

Lovaas, O. I., Litrownik, A., & Mann, R. (1971). Response latencies to auditory stimuli in autistic children engaged in self-stimulatory behavior. *Behavior Research and Therapy, 9*(1), 39–49. https://doi.org/10.1016/0005-7967(71)90035-0

Maag, J. W., Rutherford, R. B., Wolchik, S. A., & Parks, B. T. (1986). Brief report: Comparison of two short overcorrection procedures on the stereotypic behavior of autistic children. *Journal of Autism and Developmental Disorders, 16*, 83–87. https://doi.org/10.1007/BF01531581

Mazaleski, J. L., Iwata, B. A., Vollmer, T. R., Zarcone, J. R., & Smith, R. A. (1993). Analysis of the reinforcement and extinction components in DRO contingencies with self-injury. *Journal of Applied Behavior Analysis, 26*(2), 143–156. https://doi.org/10.1901/jaba.1993.26-143

Mazaleski, J. L., Iwata, B. A., Rodgers, T. A., Vollmer, T. R., & Zarcone, J. R. (1994). Protective equipment as treatment for stereotypic hand mouthing: Sensory extinction or punishment effects? *Journal of Applied Behavior Analysis, 27*(2), 345–355. https://doi.org/10.1901/jaba.1994.27-345

McCord, B. E., Grosser, J. W., Iwata, B. A., & Powers, L. A. (2005). An analysis of response-blocking parameters in the prevention of pica. *Journal of Applied Behavior Analysis, 38*(3), 391–394. https://doi.org/10.1901/jaba.2005.92-04

McDougle, C. J., Kresch, L., Goodman, W. K., Naylor, S. T., Volkmar, F. R., Cohen, D. J., et al. (1995). A case-controlled study of repetitive thoughts and behavior in adults with autistic disorder and obsessive compulsive disorder. *The American Journal of Psychiatry, 152*(5), 772–777. https://doi.org/10.1176/ajp.152.5.772

McKenzie, S. D., Smith, R. G., Simmons, J. N., & Soderlund, M. J. (2008). Using a stimulus correlated with reprimands to suppress automatically maintained eye poking. *Journal of Applied Behavior Analysis, 41*(2), 255–259. https://doi.org/10.1901/jaba.2008.41-255

Morrison, K., & Rosales-Ruiz, J. (1997). The effect of object preferences on task performance and stereotypy in a child with autism. *Research in Developmental Disabilities, 18*(2), 127–137. https://doi.org/10.1016/S0891-4222(96)00046-7

Ollendick, T. H., Matson, J. L., & Martin, J. E. (1978). Effectiveness of hand overcorrection for topographically similar and dissimilar self-stimulatory behavior. *Journal of Experimental Child Psychology, 25*(3), 396–403. https://doi.org/10.1016/0022-0965(78)90063-2

Pace, G. M., Ivancic, M. T., Edwards, G. L., Iwata, B. A., & Page, T. J. (1985). Assessment of stimulus preference assessment and reinforcer value with profoundly retarded individuals. *Journal of Applied Behavior Analysis, 18*(3), 249–255. https://doi.org/10.1901/jaba.1985.18-249

Pendergrass, V. E. (1972). Timeout from positive reinforcement following persistent, high-rate behavior in retardates. *Journal of Applied Behavior Analysis, 5*(1), 85–91. https://doi.org/10.1901/jaba.1972.5-85

Piazza, C. C., Hanley, G. P., & Fisher, W. W. (1996). Functional analysis and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 29*(4), 437–450. https://doi.org/10.1901/jaba.1996.29-437

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., et al. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31*(2), 165–189. https://doi.org/10.1901/jaba.1998.31-165

Piazza, C. C., Adelinis, J. D., Hanley, G. P., Goh, H., & Delia, M. D. (2000a). An evaluation of the effects of matched stimuli on behaviors maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 33*(1), 13–27. https://doi.org/10.1901/jaba.2000.33-13

Piazza, C. C., Hanley, G. P., Blakely-Smith, A., & Kinsman, A. M. (2000b). Effects of search skills training on the pica of a blind boy. *Journal of Developmental and Physical Disabilities, 12*, 35–41. https://doi.org/10.1023/A:1009404226669

Potter, J. N., Hanley, G. P., Augustine, M., Clay, C. J., & Phelps, M. C. (2013). Treatment of stereotypy in adolescents with autism by refining the tactic of "using stereotypy as reinforcement". *Journal of Applied Behavior Analysis, 46*(2), 407–423. https://doi.org/10.1002/jaba.52

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Virues Ortega, J., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46*(1), 47–60. https://doi.org/10.1002/jaba.26

Rapp, J. T. (2006). Toward an empirical method for identifying matched stimulation for automatically reinforced behavior: A preliminary investigation. *Journal of Applied Behavior Analysis, 39*(1), 137–140. https://doi.org/10.1901/jaba.2006.37-05

Rapp, J. T. (2007). Further evaluation of methods to identify matched stimulation. *Journal of Applied Behavior Analysis, 40*(1), 73–88. https://doi.org/10.1901/jaba.2007.142-05

Rapp, J. T., & Vollmer, T. R. (2005). Stereotypy I: A review of behavioral assessment and treatment. *Research in Developmental Disabilities, 26*(6), 527–547. https://doi.org/10.1016/j.ridd.2004.11.005

Rapp, J. T., Vollmer, T. R., St. Peter, C., Dozier, C. L., & Cotnoir, N. M. (2004). Analysis of response allocation in individuals with multiple forms of stereotyped behavior. *Journal of Applied Behavior Analysis, 37*(4), 481–501. https://doi.org/10.1901/jaba.2004.37-481

Reid, D. H., Parsons, M. B., Phillips, J. F., & Green, C. W. (1993). Reduction of self-injurious hand mouthing using response blocking. *Journal of Applied Behavior Analysis, 26*(1), 139–140. https://doi.org/10.1901/jaba.1993.26-139

Repp, A. C., Deitz, S. M., & Speir, N. C. (1974). Reducing stereotypic responding of retarded persons by the differential reinforcement of other behavior. *American Journal of Mental Deficiency, 79*, 279–284.

Repp, A. C., Deitz, S. M., & Deitz, D. E. D. (1976). Reducing inappropriate behaviors in a classroom and in individual sessions through DRO schedules of reinforcement. *Mental Retardation, 14*, 11–15.

Richler, J., Bishop, S. L., Kleinke, J. R., & Lord, C. (2007). Restricted and repetitive behavior disorders in young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*, 73–85. https://doi.org/10.1007/s10803-006-0332-6

Rincover, A., Cook, R., Peoples, A., & Packard, D. (1979). Sensory extinction and sensory reinforcement principles for programming multiple adaptive behavior change. *Journal of Applied Behavior Analysis, 12*(2), 221–233. https://doi.org/10.1901/jaba.1979.12-221

Ringdahl, J. E., Vollmer, T. R., Marcus, B. A., & Roane, H. S. (1997). An analogue evaluation of environmental enrichment: The role of stimulus preference. *Journal of Applied Behavior Analysis, 30*(2), 203–216. https://doi.org/10.1901/jaba.1997.30-203

Risley, T. R. (1968). The effects and side effects of punishing the autistic behaviors of a deviant child. *Journal of Applied Behavior Analysis, 1*(1), 21–34. https://doi.org/10.1901/jaba.1968.1-21

Roane, H. S., Kelly, M. L., & Fisher, W. W. (2003). The effects of noncontingent access to food on the rate of object mouthing across three settings. *Journal of Applied Behavior Analysis, 36*(4), 579–582. https://doi.org/10.1901/jaba.2003.36-579

Rollings, J. P., & Baumeister, A. A. (1981). Stimulus control of stereotypic responding: Effects on target and collateral behavior. *American Journal of Mental Deficiency, 86*, 67–77.

Rooker, G. W., Bonner, A. C., Dillon, C. M., & Zarcone, J. R. (2018). Behavioral treatment of automatically reinforced SIB: 1982–2015. *Journal of Applied Behavior Analysis, 51*(4), 974–997. https://doi.org/10.1002/jaba.492

Saini, V., Greer, B. D., Fisher, W. W., Lichtblau, K. R., DeSouza, A. A., & Mitteer, D. R. (2016). Individual and combined effects of noncontingent reinforcement and response blocking on automatically reinforced problem behavior. *Journal of Applied Behavior Analysis, 49*(3), 693–698. https://doi.org/10.1002/jaba.306

Schmidt, J. D., Falligant, J. M., Goetzel, A., Hardisty, S., & Hagopian, L. P. (2021). Decreasing motor stereotypy with competing stimulus and tasks: Analysis of prompted engagement and response blocking. *Behavioral Interventions, 36*(3), 583–594. https://doi.org/10.1002/bin.1786

Schroeder, A., Schroeder, C., Smith, B., & Dalldorf, J. (1978). Prevalence of self-injurious behavior in a large state facility for the retarded. *Journal of Autism and Child Schizophrenia, 8*, 261–269. https://doi.org/10.1007/BF01539629

Shore, B. A., Iwata, B. A., DeLeon, I. G., Kahng, S. W., & Smith, R. G. (1997). An analysis of reinforcer substitutability using object manipulation and self-injury as competing responses. *Journal of Applied Behavior Analysis, 30*(1), 21–41. https://doi.org/10.1901/jaba.1997.30-21

Sidener, T. M., Carr, J. E., & Firth, A. M. (2005). Superimposition and withholding of edible consequences as treatment for automatically reinforced stereotypy. *Journal of Applied Behavior Analysis, 38*(1), 121–124. https://doi.org/10.1901/jaba.2005.58-04

Smith, E. A., & Van Houten, R. (1996). A comparison of the characteristics of self-stimulatory behaviors in "Normal": Children and children with developmental delays. *Research in Developmental Disabilities, 17*(4), 253–268. https://doi.org/10.1016/0891-4222(96)00007-8

Smith, R. G., Russo, L., & Le, L. D. (1999). Distinguishing between extinction and punishment effects of response blocking: A replication. *Journal of Applied Behavior Analysis, 32*(3), 367–370. https://doi.org/10.1901/jaba.1999.32-367

Soke, G. N., Rosenberg, S. A., Hamman, R. F., Fingerlin, T., Robinson, C., Carpenter, L., Giarelli, E., Lee, L., Wiggins, L. D., Durkin, M. S., & DiGuiseppi, C. (2016). Brief report: Prevalence of self-injurious behaviors among children with autism spectrum disorder – A population-based study. *Journal of Autism and Developmental Disorders, 46*, 3607–3614. https://doi.org/10.1007/s10803-016-2879-1

Taylor, B. A., Hoch, H., & Weissman, M. (2005). The analysis and treatment of vocal stereotypy in a child with autism. *Behavioral Interventions, 20*(4), 239–253. https://doi.org/10.1002/bin.200

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*, 16–23. https://doi.org/10.1007/BF03391716

Tiger, J. H., Wierzba, B. C., Fisher, W. W., & Benitez, B. (2017). Developing and demonstrating inhibitory stimulus control over repetitive behavior. *Behavioral Interventions, 32*(2), 160–174. https://doi.org/10.1002/bin.1472

Toussaint, K. A., & Tiger, J. H. (2012). Reducing covert self-injurious behavior maintained by automatic reinforcement through a variable momentary DRO procedure. *Journal of Applied Behavior Analysis, 45*(1), 179–184. https://doi.org/10.1901/jaba.2012.45-179

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal *of Applied Behavior Analysis, 21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Verriden, A. L., & Roscoe, E. M. (2019). An evaluation of a punisher assessment for decreasing automatically maintained problem behavior. *Journal of Applied Behavior Analysis, 52*(1), 205–226. https://doi.org/10.1002/jaba.509

Virues-Ortega, J., Clayton, K., Pèrez-Bustamante, A., Gaerlan, B. F. S., & Fahmie, T. A. (2022). Functional analysis patterns of automatic reinforcement: A review and component analysis of treatment effects. *Journal of Applied Behavior Analysis, 55*(2), 481–512. https://doi.org/10.1002/jaba.900

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15*(3), 187–207. https://doi.org/10.1016/0891-4222(94)90011-6

Vollmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities, 13*(4), 393–417. https://doi.org/10.1016/0891-4222(92)90013-V

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: Noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26*(1), 9–21. https://doi.org/10.1901/jaba.1993.26-9

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. A. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27*(2), 331–344. https://doi.org/10.1901/jaba.1994.27-331

Watkins, N., & Rapp, J. T. (2014). Environmental enrichment and response cost: Immediate and subsequent effects on stereotypy. *Journal of Applied Behavior Analysis, 47*(1), 186–191. https://doi.org/10.1002/jaba.97

Wolery, M., Kirk, K., & Gast, D. L. (1985). Stereotypic behavior as a reinforcer: Effects and side effects. *Journal of Autism and Developmental Disorders, 15*, 149–161. https://doi.org/10.1007/BF01531601

Zarcone, J. R., Iwata, B. A., Mazaleski, J. L., & Smith, R. G. (1994). Momentum and extinction effects on self-injurious escape behavior and noncompliance. *Journal of Applied Behavior Analysis, 27*(4), 649–658. https://doi.org/10.1901/jaba.1994.27-649

Zhou, L., Goff, G. A., & Iwata, B. A. (2000). Effects of increased response effort on self-injury and object manipulation as competing responses. *Journal of Applied Behavior Analysis, 33*(1), 29–40. https://doi.org/10.1901/jaba.2000.33-29

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13 Transition-Related Problem Behavior

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Introduction

Resistance to change or insistence on sameness is one of the core features of autism spectrum disorder (ASD), characterized by extreme emotional outbursts or challenging behavior in response to even small changes in the environment (American Psychiatric Association, 2013). Results of factor-analytic studies suggest that resistance to change is a higher-order response pattern that is separate and distinct from lower-order repetitive behavior (e.g., motor stereotypies). Higher-order response patterns, such as compulsivity (i.e., behavior that is repeated often and follows specific rules) and sameness behavior (i.e., resistance to change or insisting that things stay the same), are prevalent among children with ASD.

Research shows that change-resistant behavior occurs across multiple contexts (Joseph et al., 2013) and will stay the same or worsen over time if left untreated (Neil & Sturmey, 2014; Richler et al., 2010). Children may display resistance to change with their daily routines or schedules, with the physical environment, activities, or location, to name a few. For example, a child might insist on following specific routes to and from a given destination or completing certain activities before transitioning to new ones. Wing and Gould (1979) found that 94% of children with ASD had a history of elaborate routines versus 2% of children without ASD. In addition, Lam and Aman (2007) determined, based on the results of 302 surveys completed by caregivers of children with ASD, that 77% of their children engaged in challenging behavior during transitions and had difficulties with changing to new activities.

Given that transitions represent a common period of change that can be challenging for many individuals, researchers have evaluated the conditions in which problem behavior occurs and the strategies that may help to mitigate or treat problem behavior in these contexts. Luczynski and Rodriguez (2015) defined a *transition* as the period of time or the process during which one activity, event, or stimulus context ends and another begins. Further, Luczynski and Rodriguez identified that transitions could be structurally broken down into three parts that include: “(a) termination of the pre-change context, (b) initiation of the post-change context, and (c) the period between the two contexts” (p. 153). Transitions could involve a physical change in location, such as walking from the classroom to the school cafeteria or could require that the child follow specific directions to restore the environment to its previous state (e.g., stow away toys) or prepare for the next event (e.g., retrieve toothbrush and paste). Transitions could involve a cue or signal, could occur as part of the child’s regular daily routine, or could involve an unexpected change of events.

We use the term transition-related problem behavior (TRPB) to encompass the many challenging topographies of problem behavior that have been reported in the literature. These include disruptions (e.g., negative vocalizations, property destruction; Deshais et al., 2018), uncooperative behavior (e.g., flopping to the ground, tantrums; Schreibman et al., 2000), severe destructive behavior (e.g., aggression; Waters et al., 2009), and elopement (e.g., running or wandering away; Lehardy et al., 2013), to name a few. In school settings, administrators have reported severe problems such as fighting between students, theft, or harassment (Taylor-Greene et al., 1997). According to Colvin et al. (1997), 50% of challenging behavior that occurs during the school day occurs in non-classroom settings at times that students are transitioning from one activity to the next.

There are several environmental factors that may contribute to the development and maintenance of TRPB. Children with ASD may engage in TRPB if the transition involves a novel change from the typical routine, especially if that change was unexpected or not signaled. It could be that predictability is automatically reinforcing for children with ASD and the presentation of sudden or novel changes creates an aversive context. Problem behavior also may be maintained by (a) access to the appetitive stimuli (e.g., attention, toys) that were present in the original context, (b) escape from the putative aversive stimuli (e.g., homework) present in the new context or in the period between contexts (e.g., physical movement from one location to the next), (c) a combination of these factors, or (d) automatic reinforcement (e.g., physical movement itself). For example, transitions that involve having to relinquish highly preferred items to proceed to a less preferred activity might evoke TRPB. Transitions requiring effort or compliance with non-preferred movements, such as having to clean a play area or walk up a flight of stairs, may also result in problem behavior.

Transition periods can be further complicated by the physical elements of the transition environment. For example, transitions that involve a change in location often occur in settings that are potentially unsafe (e.g., stairwells and doorways) or prone to limited supervision or structure (e.g., crowded hallways, bathrooms; Colvin et al., 1997). Colvin et al. reported that teachers may experience challenges with facilitating transitions in part because expectations during the transitionary period may not be clear or may differ from one setting to the next (e.g., it is appropriate for the child to engage in loud vocalizations outdoors but not indoors).

TRPB can present numerous safety risks and can result in significant impairment. Self-injury, aggression, and property destruction can cause harm to the child, others, or the surrounding environment. Problem behavior in general, and TRPB specifically, can be stigmatizing for the child and could interfere with opportunities for learning and social interaction (Varni et al., 1979). Teachers have reported difficulties with regaining instructional control following instances of TRPB (e.g., running, shoving, screaming) that occurred during transitions to and from the classroom (Colvin et al., 1997), which could be problematic for the child's learning environment or serve as a distraction for others. Challenging behavior that occurs because of change may discourage caregivers from attempting to present novel activities or stimuli or avoiding the change altogether. Because that transitions or unexpected changes to routines are inevitable, caregivers may experience anxiety or frustration in these situations.

Elopement, defined as leaving a safe and/or supervised area without caregiver permission (Lehardy et al., 2013), occurs in approximately 25–50% of children with ASD, and is commonly reported during transition-related events. Elopement poses serious safety risks, such as the possibility of drowning incidents, traffic-related injuries, or abduction. According to a recent epidemiologic study by Guan and Li (2017), individuals with ASD are at much greater risk of drowning-related deaths which could be due, in part, to the prevalence of elopement behavior. Anderson et al. (2012) found that 49% of caregivers of children with ASD reported at least one elopement attempt after 4 years of age, with 26% of those children missing long enough to cause concern. Of those who went missing, a majority were identified as encountering dangerous situations that could have potentially resulted in injury or death. In addition, caregivers report elopement as a significant source of anxiety and stress (Anderson et al., 2012).

The problematic, and in some cases life-threatening, consequences highlight the importance of addressing TRPB. Developing effective prevention, assessment, and intervention strategies is critical because life is often unpredictable and avoiding change is nearly impossible (Boyd et al., 2012; Leekam et al., 2011). Given the prevalence of TRPB among children with ASD, the aim of this chapter is to review current research involving assessment and treatment strategies and discuss considerations for treatment selection and future research. We begin by describing the conceptual, behavior-analytic foundations of TRPB.

The Development of Transition-Related Problem Behavior

Basic behavioral research has shown that certain types of transitions reliably disrupt operant behavior. In a now seminal study on behavior across different transition types, Perone and Courtney (1992) arranged four general types of transitions which varied the duration (in seconds) of grain access for pigeons' keypeck responses on fixed-ratio schedules of reinforcement. Under test conditions, prior reinforcer magnitudes were either small or large (e.g., 0.5 s or 7.5 s of grain access, respectively), and upcoming reinforcer magnitudes were equally small or large. Thus, the birds experienced transitions of the following reinforcer magnitudes: small–small, small–large, large–small, large–large. Additionally, the researchers programmed differing reinforcer magnitudes to test the generality of responding under more and less extreme differences in reinforcer magnitudes. For example, in one test condition, the small magnitude was 2 s, and the large magnitude was 6 s, whereas in another test condition, the small magnitude was 0.5 s, and the large magnitude was 7.5 s. Responding under the test conditions was compared to responding under a control condition in which past and upcoming reinforcer magnitudes were equal (e.g., 4 s of grain access for each).

Perone and Courtney (1992) first examined transition behavior when transitions were unsignaled using a mixed schedule of reinforcement. Under this arrangement, the response key was lit with a constant color, and the pigeons were unable to determine in advance whether the upcoming reinforcer magnitude was small or large. The researchers found that unsignaled transitions disrupted responding more (i.e., more pausing before initiating the next ratio run) when the past reinforcer magnitude was large rather than when it was small, suggesting that events that transpire before a transition partly determine responding during the transition. Additionally, the authors found that more reinforcing past events disrupted behavior more so than less reinforcing past events, as pausing was most pronounced across the test conditions when pigeons recently completed a ratio run that produced the largest magnitude reinforcer programmed.

In the same study, Perone and Courtney (1992) extended these already impressive findings by examining the effects of signals on transition behavior. The researchers used the same general framework described above and converted the unsignaled (mixed) schedules of reinforcement to signaled (multiple) schedules in which small and large reinforcer magnitudes were correlated with distinct colors (i.e., blue and yellow for one bird, blue and white for another bird). The researchers found that superimposing these event-correlated stimuli came to control transition behavior in another way—pigeons' responding became sensitive to the upcoming event in addition to the past event. Thus, the researchers concluded that "pausing between ratios is jointly determined by two competing factors: past conditions of reinforcement and stimuli correlated with upcoming conditions" (Perone & Courtney, 1992, p. 33).

The important work of Perone and Courtney (1992) has been replicated numerous times since its publication and has been extended by others to encompass different types of transitions (e.g., fixed-interval schedules), other problematic topographies of transition behavior (e.g., aggression), and different species (e.g., humans; Pitts et al., 2019; Toegel & Perone, 2022; Wade-Galuska et al., 2005; Williams et al., 2011; Williams et al., 2019). Indeed, the collective findings from the literature on this topic have shown such considerable replicability and generality that Wade-Galuska et al. (2005) concluded regarding their findings, "In concert with previous research,…(our) results support the general proposition that behavior is disrupted by abrupt, discriminable transitions from favorable to unfavorable schedule conditions, across a range of subjects and operational definitions of favorability" (Wade-Galuska et al., 2005, p. 91). Other researchers have convincingly shown that such rich–lean transitions are aversive with pausing during rich–lean transitions being conceptualized as avoiding or escaping aversive aspects of the transition (Langford et al., 2019; Langford et al., 2021; Pitts et al., 2019; Williams et al., 2019; see Perone, 2003 for discussion on the aversive effects of positive reinforcement). These findings that mirror early work by Azrin et al. (1966) on extinction-induced aggression occasioned by alternating periods of reinforcement and extinction and other work by Mulvaney et al. (1974) and Jwaideh and Mulvaney (1976) on the aversive functions of stimuli correlated with extinction and the lower of two signaled rates of reinforcement, respectively.

Extending this understanding of the aversive properties of some transition types to the development of TRPB in individuals with ASD is relatively straightforward. Initially, schedule-induced behavior (e.g., pausing or general noncompliance with instructions to transition, emotional responding, tantrums, and/or aggression) may be elicited from signaled transitions that involve a worsening of reinforcement conditions (e.g., transitions from the playground to the classroom at school or to a parent's vehicle). Teachers or caregivers upon observing such problematic, schedule-induced behavior after initiating the transition may "give in" to the child by delaying or otherwise altering the upcoming transition to escape the child's problem behavior (i.e., a negative reinforcement contingency; Allen & Warzak, 2000). This may take the form of postponing a scheduled time to transition, changing the upcoming activity or location (e.g., "Okay. We will stop for ice cream on the way home."), or perhaps making available previously restricted competing stimuli (e.g., allowing the child to watch their favorite cartoons in the car) to ease the transition. When such modifications occur in the presence of problematic, schedule-induced behavior, the child may learn to emit similar responses during future difficult transitions. Thus, noncompliance, emotional responding, tantrums, and aggression may take on an operant function. This dual respondent–operant function of TRPB makes identifying effective strategies for dealing with it safely and for discouraging its occurrence even more imperative.

Proactive Strategies for Children with Autism Spectrum Disorder

Even prior to assessment or treatment of TRPB, practitioners and caregivers can use antecedent-based strategies to prevent the development of TRPB or minimize risk. Antecedent-based manipulations also could serve as a mediating strategy to maintain child safety and promote awareness while practitioners assess the functional variables that maintain TRPB to identify effective treatment (Phillips et al., 2018). When designing antecedent-based strategies, practitioners should consider the role of establishing operations and whether changes can be made to the physical environment to promote cooperation or reduce the likelihood of TRPB. Safety equipment or increased monitoring and security systems represent a set of strategies that might effectively minimize risk (Andersen et al., 2020; McLaughlin et al., 2020). In the following section, we review several promising antecedent-based strategies for TRPB.

Modifications to the Physical Environment

Caregivers could adjust the physical environment to decrease the likelihood of TRPB or increase children's safety during transitions. If practitioners can identify the events that commonly occasion TRPB or ways in which the physical setting could be arranged differently, adjusting the physical environment could serve as a relatively simple or straightforward strategy. For example, if a teacher's vocal instruction to line up at the door after lunch results in one child's elopement, the teacher could arrange for the child to be seated at a table closest to the door and refrain from issuing the instruction until they are in close proximity to the child to block elopement attempts.

Andersen et al. (2020) surveyed caregivers of children with ASD to learn more about the strategies they use to prevent or decrease their child's elopement or the associated risks. Modifications to the physical environment were among the highest rated strategies in terms of their perceived effectiveness, cost, and level of effort to implement. Modifications included increasing the number of physical barriers around the home, such as adding door or window locks or outdoor fencing. Of these, the antecedent manipulations that caregivers reported to be most effective with the least amount of burden or effort included yard fencing and window locks. Other low-effort, inexpensive modifications could include re-arranging the physical setting, such as creative positioning of desks in the classroom or furniture in the home and ensuring that all doors are closed with locks that are placed outside of the child's reach (Fisher et al., 2013).

Practitioners should consider caregiver preference for and willingness to use the various strategies involving physical modifications to the environment. For example, fire codes could prevent the locking of certain doors or moving furniture to areas that could block entrance and exit points. Expense represents another critical factor that might affect caregiver use of environmental modifications. Based on the caregiver reports from Andersen et al. (2020), physical modifications ranged in price, but overall were not as costly as other recommended approaches (e.g., acquiring a service animal). Although yard fencing could serve as a costly endeavor, families reported frequent use of fencing, perhaps because it served multiple purposes and was worth the added cost. In our clinic, we actively involve social workers as part of a multidisciplinary treatment team to determine mechanisms by which caregivers can access important financial and physical resources to assist in this area.

Increasing Security, Monitoring, and Awareness

Location-signaling technology such as electronic tracking devices or global positioning systems (GPS) may be useful to minimize specific types of TRPB, such as elopement or to decrease associated risks (McLaughlin et al., 2020). Tracking devices may not prevent or stop elopement from occurring in the moment, but they could be helpful in reducing caregiver stress given that they can provide real-time feedback regarding child location. If caregivers could track the child more consistently, they could better prevent the child from eloping to potentially dangerous areas (e.g., swimming pools). However, surveys of caregivers indicate less buy-in for technological methods of reducing elopement (Andersen et al., 2020; Kiely et al., 2016; McLaughlin et al., 2020). For example, in their survey of caregivers of children with ASD, McLaughlin et al. (2020) found that caregivers' reasons for not using electronic tracking devices included possible child discomfort with application, increased effort to prompt the child to wear the device, or that it was too costly, and Kiely et al. (2016) found that caregivers were six to ten times more likely to use physical over technological modifications to reduce elopement.

In addition to physical modifications to the environment or use of tracking devices, caregivers sometimes employ strategies to increase awareness in case a child became lost, such as identification shoe tags or bracelets (Andersen et al., 2020). Advocacy groups have developed resources for caregivers of children who frequently elope, such as The National Autism Association's comprehensive safety guide known as the "Big Red Safety Toolkit" (National Autism Association, 2014). This digital resource includes information on creative home safety precautions, wearable devices, and measures to increase community awareness. One product our clinic has used for children who have difficulty tolerating identification wearables is temporary safety tattoos (e.g., http://www.safetytat.com/), which can last up to two weeks at a time. Children may prefer these products due to incorporation of cartoon characters and similarity to temporary tattoos used in leisure activities (e.g., birthday party favors), and caregivers report preferring this type of identification mechanism because it cannot be easily removed.

Given that TRPB commonly occurs in schools, researchers have evaluated various antecedent-based strategies to reduce or prevent TRPB in these settings (Colvin et al., 1997; Deshais et al., 2018). Colvin et al. evaluated a school-wide antecedent-based intervention involving active supervision and a pre-correction procedure. Colvin et al. defined the active supervision component as supervisors displaying overt and specific behavior, such as turning their head to actively scan the room or closely escorting children from one location to the next. The pre-correction procedure involved verbal reminders or warnings and various role-play or practice opportunities that teachers prompted children to do before or outside of the actual transition period. This resulted in improvements in adult supervision child transitions.

Colvin et al.'s (1997) study may have larger implications for teachers who experience challenges during transitions throughout the school day. Researchers should continue to evaluate interventions to increase staff attentiveness, proximity to, and interactions with children as they transition, to minimize unsupervised or unstructured periods. Colvin et al. indicated that these interventions required little training time for staff members (e.g., 15 min) and had other beneficial effects, such as allowing teachers to start the subsequent classes that followed transitions on time. These researchers proposed that active supervision practice (e.g., continuous scanning of the room, interacting and engaging with children) was more important than the total number of supervising individuals. This finding is noteworthy if it can save school districts time and funds that would typically be allocated to hiring and training additional team members to minimize problematic transition periods.

Assessment of Transition-Related Problem Behavior

The first step in addressing behavioral challenges during transitions is to evaluate the conditions in which these challenges occur. Interviewing relevant stakeholders and conducting observations in the natural environment to determine the topographies of TRPB and when the behavior occurs are important. Before conducting a functional analysis, direct observation of the behavior may allow the identification of certain patterns that can inform the arrangement or setup of test conditions. For example, if TRPB often occurs when a teacher prompts a student to transition to math class, math work could be presented during the escape test condition of a functional analysis.

If TRPB includes wandering or elopement, it may be useful to identify common response or movement patterns. Jessel et al. (2016) designed a transition assessment to evaluate child responding between rich and lean schedules of reinforcement by dividing a room into two, 2-m by 2-m areas between which the participants had to physically transition. The path between the two contexts was a straight line, but when researchers observed that participants did not always move in a straight line, they followed the participants to draw the path and identify patterns of wandering. When the transition was from a lean-to-rich schedule of reinforcement, the participant did not wander or pause and transitioned according to a relatively direct path. When the transition was from a rich-to-lean schedule, the participant frequently walked to other points in the room, especially toward his mother (who was in the same room) or walked in circles before transitioning to the section of the room associated with the lean schedule of reinforcement. A similar approach could inform practitioners when wandering or elopement occur, but also potentially if wandering and elopement are directed in the area of a certain item, person, or activity, such as it was for the participant in Jessel et al. (2016).

Functional Analysis of Transition-Related Problem Behavior

As behavior analysts, we focus on identifying the variables maintaining challenging behavior so we can select the most appropriate function-based treatment; TRPB should be assessed similarly. Practitioners should aim to arrange safe and efficient assessments that will lead to the most parsimonious results. Challenges that are specific to transitions, such as the role of multiple contingencies on behavior (e.g., behavior multiply controlled by social negative and positive reinforcement in the form of escape from the transition and access to previous activities), should be considered when developing assessments. As noted by Luczynski and Rodriguez (2015), when caregivers report difficulties with transitions, it is unlikely they experience these challenges during every small stimulus change that occurs throughout the day. Alternatively, it is likely that caregivers encounter problem behavior during transitions that involve the termination of a given activity to the onset of a completely different activity. Nevertheless, to avoid superfluous treatment components that could result from incorrectly identifying a function as part of a synthesized anaylsis, practitioners should exhaust efforts to rule out whether TRPB is maintained by single or multiple contingencies by first examining contingencies in isolation before combining them.

Results of interviews with caregivers to identify functions of behaviors are often inaccurate (Dracobly et al., 2018; Saini et al., 2020). In addition, it may be problematic to use complicated assessments if they lead to more complicated treatment packages. More complicated treatments, which include contingencies that may not be function-based, may require unnecessary time and effort, or may result in an intervention that is too challenging for caregivers to maintain with high fidelity (Kirkwood et al., 2021). Traditional functional analyses (Iwata et al., 1982/1994) may be sufficient to capture the variable(s) maintaining challenging behavior during transitions and identify a straightforward intervention. For example, traditional functional analyses could identify when child TRPB is maintained by social positive reinforcement (e.g., access to previous, preferred activity) and then design an intervention that involves access to the preferred activity contingent on appropriate behavior during transitions. If the results of traditional functional analyses are undifferentiated, practitioners could develop or use additional assessment tools. Only a handful of studies have found automatically maintained TRPB (e.g., Piazza et al., 1997). However, if caregivers report a tendency for TRPB to occur regardless of adult consequences, it may be worth running a series of consecutive alone or ignore sessions within a safe environment to observe if TRPB maintains in the absence of social consequences prior to a multielement functional analysis.

Alternatives to Traditional Functional Analyses

Traditional functional analyses may not be sufficient if the antecedents for TRPB involve both the termination of an activity and the presentation of a new activity. In addition, if practitioners are unable to ensure safety precautions while conducting more traditional functional analyses, they may look to the literature for examples of other variables to assess or consider (e.g., Blowers et al., 2020; Flannery & Horner, 1994; McCord et al., 2001). In the case of behavior that is jointly maintained by social negative and positive reinforcement, practitioners may not observe differentiation between the isolated test conditions and the control and therefore will need to design a condition to test for combined contingencies. In combined test conditions, practitioners could identify activities that when terminated, most often evoke TRPB through initial observations in the natural environment or caregiver interviews. In the test condition, the practitioner would terminate the activity and present the transition-related stimulus (e.g., vocal statement that it is time to do homework, picture card identifying the walk to the classroom). Contingent on the first instance of TRPB, the practitioner would end the transition and re-present the original activity.

A traditional functional analysis may not be sufficient if the antecedents for the problem behavior are specific to the physical movements involved in the transition. For example, the demand to physically move between activities may be the antecedent for TRPB. McCord et al. (2001) tested physical movement as an antecedent. To arrange this test condition, McCord et al. created identical pre- and post-transition contexts to serve as a neutral location. During the assessment, researchers vocally instructed the individual to physically move 7–10 m from the pre- to the post-transition context, to determine whether the demand for the individual to engage in physical movement during the transition evoked problem behavior. If the individual engaged in problem behavior during the transition, researchers physically guided them back to the pre-transition context. McCord et al. compared this test condition to extended sessions conducted in a neutral context without physical movement.

If researchers suspect that physical movement is aversive and the individual engages in TRPB to escape or avoid physical movement but do not observe differentiated patterns of responding in the above assessment, they might consider assessing combined contingencies. See McCord et al. (2001) for additional helpful examples for how to test specific pre-and post-transition contexts both with and without physical movement during the transition. For example, one test condition might include a neutral pre-transition context as well as a demand in the post-transition context. In this arrangement, researchers could test one condition that involves physical movement to one that does not. Contingent on TRPB, the researcher would return the participant to the previous context. As Boyle and Adamson (2017) noted in their review of elopement literature, many may assume that the function of TRPB, such as elopement, is maintained by escape. However, these authors found that elopement was most often maintained by social positive reinforcement in the form of access to tangibles and preferred activities, and second, to attention. McCord et al. tested for different positive reinforcement contingencies by separating them out in different pre-transition contexts; one context included attention, another a preferred toy, and the third, a preferred food. However, for some individuals the type of attention maintaining challenging behavior during transitions could be more idiosyncratic and not captured in a typical attention test condition. For example, if a child flops or refuses to move, a caregiver could repeat verbal prompts or physically move the child; if the child elopes, the caregiver could chase the child.

Most caregivers will undoubtedly follow their child if they elope away in public areas. This adult behavior is unlike the traditional forms of attention delivered in a functional analysis (e.g., reprimands, soothing attention) but could be a potent consequence for TRPB like elopement. Blowers et al. (2020) conducted an assessment to determine if attention in the form of chase maintained elopement for a child diagnosed with ASD. They conducted the assessment in a 60-m long by 4-m wide hallway which they divided into three sections. The sections were marked with a red piece of construction paper to allow the authors to easily identify when elopement occurred (i.e., elopement was defined as 50% or more of the child's body crossing a red marker while running). The results indicated that adult chasing maintained elopement. This experimental procedure may be useful for identifying a function of TRPB when caregivers or practitioners suspect attention in the form of retrieval attempts.

Individuals with ASD may also engage in TRPB as one type of resistance to change. Therefore, neither the pre- and post-transition activities nor the physical movement between the transitions may evoke challenging behavior. Rather, the change in events may serve as the evocative stimulus for TRPB. Some researchers believe that the unpredictability of a transition is the aversive stimulus for individuals with ASD because their insistence on sameness inherently increases the predictability of their daily routine (Luczynski & Rodriguez, 2015). Flannery and Horner (1994) conducted an assessment to determine if predictability impacted challenging behavior for two individuals with ASD. They used the participants' normal academic schedule as the control condition. They then tested whether problem behavior would increase when the schedule of activities was random and not signaled and when the schedule was random but predictable because the activities were listed out and a timer was provided. Using a reversal design, Flannery and Horner found that problem behavior increased when the schedule was random and unpredictable. This supports the hypothesis that some individuals with ASD may exhibit TRPB when disruptions occur to the predictable sequence of events.

Safety Considerations

Special consideration should be given to the arrangement of all assessments for TRPB, especially for topographies of behavior such as elopement or dropping to the ground. Using trial-based or latency-based assessments may help to reduce the number of times the therapist must retrieve and/or reset the individual, which can confound the results due to the added attention (Phillips et al., 2018). Using a contingency reversal, like in Blowers et al. (2020), meant that chase and retrieval were available for each trial during the elopement assessment, no matter the condition. Therefore, the authors did not often need to use another method to return the child to the starting point for the next trial because it was part of the reinforcer. Boyle and Adamson (2017) found that most studies assessing elopement used retrieval procedures after reinforcement intervals. In the event that the individual does need to be reset to some starting point before initiation of the subsequent trial, practitioners should consider how and who is ensuring the individual returns to a starting location. For example, Blowers et al. used a second therapist to reset the child to the starting point if needed. Phillips et al. provided an example diagram for how to arrange a functional analysis of elopement in a school-based setting without requiring that another adult retrieve the student, creating a way that each trial could begin in the location that the previous trial ended. Boyle and Adamson (2017) also referenced a study by Lehardy et al. (2013) that used as similar strategy. Lehardy et al. (2013) divided a room in half with a piece of tape on the ground and following the reinforcement interval, the therapist moved to the side of the room that the participant was in instead of moving the participant.

There are various topographies of TRPB that could be dangerous to the individual or others if assessments are not designed with the risks in mind. Blowers et al. (2020) conducted their assessment in a hallway with closed doors at either end, which may not be ideal for preventing the child from eloping to other parts of the building and required an additional therapist present who could prevent the child from leaving the hallway. Consideration should be given to the method used by Lehardy et al. (2013), who were able to conduct a functional analysis of elopement in one room by dividing the room into two areas with tape and found that these results were no different than when they used two rooms to conduct the assessment. Jessel et al. (2016) used a similar arrangement in which they divided one room into equal 2-m by 2-m quadrants; instead of tape, the researchers used different colored mats to denote the areas, which also acted as a multiple schedule because they were evaluating transitions between schedules of reinforcement. This arrangement could be beneficial in that the assessment can be done in one room, and the physical movement between contexts is minimal and consistent. Finally, we previously discussed proactive strategies such as technology for tracking movement; such strategies should be incorporated into the assessment if TRPB is risky or dangerous and there is a potential for retrieval to go awry.

Treatment of Transition-Related Problem Behavior

A distinguishing feature of behavior analysis is its emphasis on the function of behavior in addition to its structure or topography. Indeed, a wealth of research has shown that function-based interventions for problem behavior are more effective at treating problem behavior than non-function-based interventions (e.g., Kuhn et al., 1999). Below, we describe two general classes of intervention for TRPB (treatments for socially reinforced TRPB and those for automatically reinforced TRPB) as well as safety-skill teaching strategies irrespective of function. Regardless of treatment approach, we highly encourage behavior analysts to continue the safety precautions during treatment, particularly if addressing riskier forms of TRPB.

Socially Reinforced Transition-Related Problem Behavior

Advanced Warnings and Visual-Activity Schedules

When possible and appropriate, providing advanced notification or warnings of upcoming transitions could help to minimize TRPB. For example, providing a vocal (“five more minutes and then it’s time to go inside”) or physical (sign or picture) cue that a specific activity is about to end could make the forthcoming transition more predictable and, therefore, less aversive for children who demonstrate change-resistant behavior. Researchers have found that the use of visual activity schedules (e.g., images showing a sequence of events in the individual's day) meets the standard for evidence-based practice for increasing adaptive behavior (Knight et al., 2015) and is effective for reducing TRPB (Lequia et al., 2012). For example, Schmit et al. (2000) implemented a modified picture-schedule system along with verbal cues to reduce one child with ASD's TRPB across three school settings. The photograph displayed an image of the setting and activity that was forthcoming, and the verbal cue included an instruction followed by the name of and location for the next activity (e.g., "Time to go to reading class in the library"). Across all three transition settings, researchers observed decreases in TRPB (i.e., tantrums) and increases in the child's cooperation with instructions.

Despite the wealth of studies supporting the use of advanced warnings and visual activity schedules, some studies have produced mixed findings for reducing TRPB. For example, Cote et al. (2005) determined that verbal warnings (e.g., "3 minutes until homework") and noncontingent access to preferred items (i.e., toys) were not effective at increasing three children's cooperation during transitions relative to escape extinction. Although extinction was necessary, Cote et al. reported enhanced effects in the treatment condition involving combined antecedent and extinction-based components. It could be that for some children, the warning stimulus itself could evoke TRPB if the forthcoming transition involves a worsening in the condition (e.g., transitioning to a nonpreferred activity or removal of a reinforcer), in line with the concept of the reflexive conditioned motivating operation described by Laraway et al. (2003). Nevertheless, providing advance notice represents a straightforward intervention approach that can serve as an initial strategy in a least-to-most hierarchy addressing TRPB. For more information, we refer readers to the extensive systematic reviews and tutorial papers on this procedure (Banda et al., 2009; Knight et al., 2015; Lequia et al., 2012; Rutherford et al., 2020).

Noncontingent Reinforcement

Noncontingent reinforcement (NCR) is another commonly used intervention for TRPB (Boyle & Adamson, 2017). NCR involves providing access to reinforcement irrespective of the individual's behavior and, conceptually, functions to reduce target behavior by minimizing its establishing operation or displacing it with reinforcement of other responses (Carr et al., 2000). In combination with extinction, it is likely that continuous presentation of reinforcement can also disrupt the response-reinforcer relationship (Carr et al., 2000). Though it may be difficult to ascertain the precise mechanism responsible for NCR's effects, several studies have reduced TRPB with NCR. As an example, Piazza et al. (1997) evaluated the elopement of a boy whose diagnoses included ASD. This child was reported to elope into areas and engage in risky behavior such as touching electrical cords and climbing on windowsills. As suggested by these anecdotal reports, the functional analysis indicated that elopement was maintained in part by access to tangible items (e.g., string located in a separate room). During treatment, Piazza et al. implemented NCR without extinction by providing continuous access to string-like items (e.g., shoelaces) in one room while still allowing elopement to occur to access the tangible items in the other room. Despite continued reinforcement for elopement, this NCR arrangement treated his TRPB successfully and was extended to caregivers in the home and teachers in the school.

Of course, continuous access to items is not always feasible and could be distracting to other siblings or students. Researchers have gradually thinned NCR during treatment of TRPB while maintaining good treatment effects (e.g., Kamlowsky et al., 2021). Another option is to provide NCR in the target context (e.g., the context previously associated with lean reinforcement conditions) at the onset of treatment rather than continuously at the start of the transition.

This might not be possible for all topographies of TRPB, such as dangerous elopement that fails to decrease in the absence of immediate access to reinforcement. However, Jessel et al. (2016) demonstrated a compelling and practical treatment option for less risky TRPB. In one experiment of this study, Jessel et al. found that three children with ASD exhibited more dawdling (i.e., longer transition durations) during rich-to-lean transitions compared to lean-to-rich transitions. To decrease dawdling, the authors programmed an opaque "mystery toy" bin in the lean context in which items associated with the rich condition were available during half of transition trials. These same preferred activities remained visible during lean-to-rich transitions. This arrangement produced moderate decreases in dawdling for two participants and a modest decrease for the third. This promising strategy warrants additional research to determine ways of thinning probabilistic reinforcement further, potentially combining intervention options for individuals who have difficulty relinquishing highly preferred items, and incorporating considerations for more dangerous TRPB (e.g., elopement). Nevertheless, behavior analysts considering NCR might integrate the probabilistic and concealed-item arrangement to thin NCR and make the treatment more practical.

Differential Reinforcement of Other Behavior and Alternative Behavior

Differential reinforcement of other behavior Two forms of differential reinforcement have been commonly used to treat TRPB in the literature. During differential reinforcement of other behavior (DRO), behavior analysts deliver reinforcement following the omission of target behavior for a certain amount of time. The mechanisms responsible for treatment effects have been discussed differently but likely incorporate aspects of extinction and negative punishment (if resetting the DRO following target behavior; Vollmer & Iwata, 1992) and potentially adventitious reinforcement of other behavior (Hangen et al., 2020). Despite ambiguity regarding the process responsible for change, DRO has been effective at reducing TRPB. For example, Piazza et al. (1997) treated TRPB that was multiply controlled by attention and access to edible items. During treatment, Piazza et al. implemented a 50-s DRO in which they offered a choice between 20-s attention or a small amount of chips following the absence of TRPB (i.e., attempts to elope from target area). They then made the DRO more practical by thinning reinforcement (55 s of attention or 25 s of chips following 5 min without TRPB) and conducting sessions in areas TRPB was likely to occur (e.g., hospital cafeteria, restaurants in the community).

Differential reinforcement of alternative behavior Another differential-reinforcement approach is to deliver reinforcement following a specific appropriate response rather than after an absence of TRPB. This strategy, differential reinforcement of alternative behavior (DRA), has been used to treat TRPB while increasing adaptive behavior. Because teaching and increasing specific appropriate behavior is likely a goal for many individuals with ASD, the use of DRA is a compelling alternative to NCR or DRO. As an example of its use, McCord et al. (2001) incorporated DRA when treating the TRPB of two individuals. One individual used a wheelchair and displayed self-injurious behavior when asked to move the wheelchair independently. The other displayed self-injurious behavior when asked to pick up items or move locations. McCord et al. used DRA to deliver access to preferred edibles for each individual following movement in the wheelchair and walking to pick up items, respectively. A combination of DRA with extinction and response blocking reduced TRPB for both participants, even when thinning reinforcement by requiring longer spans of appropriate behavior. Taken together, differential reinforcement represents a favorable option for treating TRPB. Indeed, in one of few consecutive case series analyses of behavioral treatments for elopement (which included data sets in which behavior failed to respond to treatment), Call et al. (2017) reported promising findings for reducing elopement with DRO or DRA, although additional procedures (e.g., punishment, response cost) were sometimes used to facilitate these effects.

Functional Communication Training

A deficit in communication skills is a hallmark symptom of ASD (American Psychiatric Association, 2013). Despite the efficacy of NCR, DRO, and some versions of DRA, none of these specifically address this deficit. Functional communication training (FCT) is a DRA-based intervention in which the alternative response is a communication request such as a vocal request or card exchange (Carr & Durand, 1985). FCT is the most commonly used treatment for socially reinforced problem behavior (Tiger et al., 2008), as has been the most published intervention for TRPB like elopement (Boyle & Adamson, 2017). Typically, behavior analysts implement FCT with extinction, which has resulted in meaningful decreases in problem behavior and increases in communication skills across many large, independent samples of individuals (Greer et al., 2016; Jessel et al., 2018; Rooker et al., 2013).

As described in tutorial papers on FCT (e.g., Greer et al., 2018), the steps are generally as follows: (a) the behavior analyst presents the establishing operation for problem behavior, (b) the behavior analyst then immediately prompts the communication response, such as by physically guiding a motor response or modeling a vocal response, and (c) the behavior analyst then delivers reinforcement immediately following the communication response regardless of whether it was prompted or independent. If problem behavior remains low, the behavior analyst can gradually delay the prompt for the communication response (e.g., 2 s, 5 s, 10 s) to allow independent communication responses to occur. For example, if an individual's TRPB is maintained by access to escape from a forthcoming activity (e.g., going to the restroom), the behavior analyst would (a) instruct the individual to go to the restroom, (b) immediately prompt the individual to ask for a break, and (c) provide a break for a period of time following the communication request. If feasible, extinction for TRPB would likely facilitate treatment effects.

As described with NCR, it is unreasonable to expect caregivers to accommodate every communication request with reinforcement. This is particularly true for transitions because most daily activities must continue to make meaningful gains in educational settings and address biological needs. For example, an adult might be able to provide a brief break from transitioning to the restroom, but it would be unsanitary and detrimental to the individual to avoid toileting or diapers changes entirely. Thankfully, reinforcement-schedule thinning during FCT has been researched extensively, offering multiple options for thinning reinforcement. Although practical, traditional delays to reinforcement that some might use with children without an ASD diagnosis (e.g., saying, "Nice asking but you need to wait" and then delivering reinforcement at a later time) sometimes fail to maintain low levels of problem behavior and can weaken newly learned communication responses (e.g., Hanley et al., 2001). Two other options have been investigated extensively, both of which circumvent many issues of traditional delay schedules.

Probabilistic delays During probabilistic delay-and-denial training (Hanley et al., 2014), a proportion of communication responses produce immediate reinforcement whereas others produce either time-based or contingency-based delays to reinforcement. Resuming our escape-maintained TRPB example, this might entail initiating a restroom transition on a few occasions but delivering immediate reinforcement for the communication requests but then requiring either the passage of time (e.g., 30 s) or a specific response (e.g., entering the restroom, emitting a tolerance response like "OK") prior to delivering a break on other occasions. This type of schedule-thinning arrangement has been successful at reducing reinforcement deliveries while maintaining low levels of problem behavior and optimal rates of communication requests, as well as increasing other adaptive behavior (Ghaemmaghami et al., 2016; Jessel et al., 2018).

Reinforcement thinning during those delay trials can be increased gradually (e.g., 30 s, 60 s) or rapidly (e.g., increasing from 8-min delay trials to 20-min denial probes; Rose & Beaulieu, 2019). Interested readers should consult Fig. 2 in Jessel et al. (2018) for an example schematic of this procedure and the Practical Functional Assessment website (https://practicalfunctional-assessment.com/) for tutorials and worksheets.

Multiple and chained schedules The second heavily researched option for thinning reinforcement during FCT is the use of multiple or chained schedules (Greer et al., 2016; Hanley et al., 2001). When using FCT with multiple and chained schedules, behavior analysts arrange at least two reinforcement schedules for communication responses, with at least one of the schedules always in effect and each correlated with a specific stimulus (e.g., colored cards or wristbands). Most commonly, these interventions arrange two schedules: (a) continuous reinforcement for communication responses in one component and (b) extinction for communication responses in the other component (Saini et al., 2016). In both multiple and chained schedules, the reinforcement component tends to end following the passage of time (e.g., 60 s of reinforcement). In multiple schedules, the extinction component generally ends following the passage of time (e.g., 240 s) whereas a response requirement like compliance with academic instructions (e.g., completing 4 worksheets) terminates it in a chained schedule.

As with probabilistic delay-and-denial training, schedule thinning can occur gradually (e.g., increasing the extinction component from 2 to 4 s in a multiple schedule; Greer et al., 2016; Hanley et al., 2001) or rapidly (e.g., increasing the extinction component from 60 to 240 s; Betz et al., 2013; Fuhrman et al., 2016). Regardless of thinning progression, the goal of these arrangements is to develop stimulus control over communication requests such that they occur exclusively during periods in which caregivers indicate reinforcement is available. For example, if TRPB is maintained by attention, a caregiver would present the extinction-correlated stimulus (e.g., a yellow card) while guiding the child to the next activity and withholding attention for any communication requests during that time. After the passage of time (e.g., 30 s) or the completion of a response requirement (e.g., walking to the dinner table), the caregiver would then present the reinforcement-correlated stimulus (e.g., a blue card) and deliver attention for communication requests at this time. These interventions have been highly successful at reducing problem behavior, establishing discriminative control over communication responses, and reducing the amount of reinforcement delivered by caregivers (e.g., Greer et al., 2016). Interested readers should consider the many tutorials and book chapters on these interventions (Fisher et al., 2015a; Greer et al., 2018; Mitteer et al., 2020; Saini et al., 2016) for procedural details.

Treatment Selection and Considerations

Efficacy of interventions All of the aforementioned interventions have been effective at treating socially reinforced TRPB. Thus, it may be challenging to determine which treatment approach is most relevant for a given client. In terms of efficacy, some systematic reviews have found more positive outcomes for FCT than NCR when treating TRPB maintained by social-positive reinforcement (Boyle & Adamson, 2017). However, there is a paucity of within-subject comparative analyses of treatment approaches for TRPB. Additionally, almost no studies report data for TRPB treatments across a large sample of individuals in a manner that limits publication bias (e.g., consecutive case series designs; Hagopian, 2020). We encourage behavior analysts to evaluate these treatment approaches in a systematic way to disseminate to others in the field.

Goals and practicality of the intervention It is best practice to consider the goals and preferences of the individual and stakeholders (e.g., caregivers, teachers) when selecting a treatment. From a practicality standpoint, NCR is probably the easiest intervention to implement in that behavior analysts simply deliver reinforcement on a time-based schedule irrespective of monitoring TRPB. NCR is likely the least-restrictive intervention, as well, due to the individual having access to the maximum amount of reinforcement without periods of extinction or resetting DRO intervals. Nevertheless, NCR might fail to reduce TRPB meaningfully or teaching specific replacement behaviors may be an important skill for the individual and stakeholders. It may be that behavior analysts find a combination of treatment approaches (e.g., FCT with noncontingent access to alternative activities during schedule thinning) to be warranted. Collaborating closely with individuals and stakeholders might help behavior analysts find that right balance between efficacy and practicality.

Treatment signals during FCT If using FCT, one consideration for selecting between reinforcement-schedule thinning options is to understand the relevance of discriminative stimuli for maintaining either low levels of problem behavior, ideal rates of communication responses, or both. For example, Fisher et al. (2015b) treated TRPB in a multiple-baseline-across-contexts design. The authors compared the use of discriminative stimuli when implementing FCT with multiple schedules to a comparable FCT arrangement without such treatment signals (i.e., a mixed schedule). Although extinction was effective at reducing TRPB across FCT treatments, communication responses were disrupted in the condition without discriminative stimuli. Ideal levels of communication responses (i.e., occurring readily during reinforcement components and not during extinction components) then transferred rapidly to new contexts. Further, researchers have demonstrated that such treatment signals can mitigate the relapse of problem behavior during common treatment challenges, such as prolonged periods of reinforcement unavailability, whereas comparable unsignaled treatment arrangements might not (Fisher et al., 2020; Fuhrman et al., 2016). Thus, use of discriminative stimuli during FCT may be warranted for some individuals with ASD whose TRPB recurs or whose communication responses extinguish during traditional unsignaled delay periods.

Extinction and response blocking Likely, the most difficult aspect of treating TRPB is implementing extinction with high treatment integrity. Consider a large-statured student who drops to the ground when asked to leave the playground and transition back to the classroom. Assuming his TRPB is maintained by continued access to the playground, escape from the classroom, or both, it may be impossible for smaller-statured teachers or staff to implement high-quality extinction by physically guiding the student back to the classroom or preventing access to the playground equipment. Blowers et al. (2020) described a child with ASD whose elopement was maintained by attention in the form of adults chasing him. One can imagine that, in most cases, caregivers would be unable to allow elopement to occur without retrieval, particularly in public areas. At the very least, it is likely that response blocking (e.g., preventing dangerous TRPB from occurring despite potential reinforcement) will be an integral safety with dangerous forms of TRPB. We refer readers to the many papers on modifying reinforcement parameters of target and alternative responses to address problem behavior without extinction (Lalli et al., 1999; MacNaul & Neely, 2018; Rajaraman et al., 2022; Trump et al., 2020). For example, one could provide more immediate, higher-magnitude, and higher-quality reinforcement for appropriate behavior than TRPB to encourage response allocation toward appropriate behavior.

Automatically Reinforced Transition-Related Problem Behavior

Compared to the above section on socially reinforced TRPB, there is a paucity of studies on treating automatically reinforced TRPB. In their systematic review of publications on assessing and treating elopement, Boyle and Adamson (2017) found only two reported cases with automatic reinforcement and neither included a treatment analysis. In our own search, we identified only two studies demonstrating treatment of automatically reinforced TRPB, though behavior analysts can likely extend the literature on treating other forms of automatically reinforced problem behavior to TRPB contexts.

Piazza et al. (1997) found that a child's elopement occurred across all functional-analysis conditions and persisted in the ignore condition, suggesting that elopement was automatically reinforced. In a follow up reinforcer assessment, the authors observed that the child would frequently select a card to access the opportunity to run freely. However, when offered choices between running and access to adult attention, the child selected the latter reinforcer. Informed by these data, Piazza et al. then developed a DRA-based intervention in which appropriate walking next to an adult resulted in reinforcement and response blocking prevented successful elopement (i.e., extinction). Piazza et al. began DRA by reinforcing brief, 5-s bouts of appropriate walking with a choice between response cards corresponding to attention (e.g., vocal praise, high-fives) or running next to the adult. The authors then used a token system to thin reinforcement such that 30 s of appropriate walking yielded one token equivalent to 15-s access to attention or running, with a token-exchange opportunity after 5 min of walking. Appropriate walking maintained at near-perfect levels across the evaluation.

In another published study on treating automatically reinforced TRPB, Boyle et al. (2019) assessed elopement of a 6-year-old girl with ASD named Abby. Her caregiver reported concerns of Abby running into narrow areas like supermarket aisles during outings, which made retrieval difficult. Boyle et al. used a multielement FA to evaluate instances of elopement within a hallway, which emulated the narrow aisles in which Abby tended to elope. Abby's elopement occurred across all test conditions and maintained during consecutive ignore sessions, suggesting that elopement was maintained, at least in part, by automatic reinforcement.

Treatment was similar to Piazza et al. (1997) and consisted of DRA, though the authors further specified this as differential reinforcement of incompatible behavior due to appropriate walking being incongruent with elopement. Boyle et al. provided a rule and then allowed Abby to run within a controlled setting following a requisite amount of appropriate walking. Because Abby's caregiver requested an intervention without response blocking, extinction was not programmed, and Abby could elope at any point during the trial. Boyle et al. successfully increased the duration of appropriate walking and these gains maintained when the authors extended treatment to other areas of the building (e.g., atrium).

Despite these positive outcomes, it will be important for behavior analysts to consider the feasibility of using access to the functional reinforcer for TRPB (e.g., running) to reinforce appropriate transition behavior, especially when the family is in public settings or unsafe areas. Shifting preferences to more practically delivered reinforcers like in Piazza et al. (1997) might be preferable, as is exploring alternative treatment options. Taking away some of the unique contextual variables with TRPB (e.g., using separate rooms such that it can occur), behavior analysts should be able to extend common treatments for other forms of automatically reinforced problem behavior to these cases. As described earlier, NCR can be an effective treatment for socially reinforced TRPB. This intervention approach has wide support for treating other forms of automatically reinforced problem behavior (e.g., Rooker et al., 2018). Interestingly, Abby's FA data in Boyle et al. (2019) show that elopement never occurred during the 5-min play (i.e., control) sessions. Thus, NCR with the highly preferred items and attention programmed during the play condition may have resulted in a successful treatment, potentially without the limitations of the DRA-based intervention. We encourage practitioners to consider NCR in the treatment of automatically maintained TRPB by following approaches used for other forms of problem behavior (e.g., informing NCR with a competing stimulus assessment, incorporating additional teaching procedures if NCR alone is insufficient; Haddock & Hagopian, 2020).

Teaching Safety Skills

As noted above, we as practitioners can teach a number of important skills to individuals with ASD to decrease the occurrence of TRPB. Despite our best efforts, the individual may encounter situations in which TRPB results in separation from caretakers or known acquaintances. For example, a caregiver might implement an FCT intervention with extinction to great success 99% of the time; however, it only takes one occasion for continuous monitoring or extinction to be unfeasible to result in life-threatening risk (e.g., if the child bolts into a busy crowd at a theme park while the caregivers attend to the child's sibling). As every parent knows, even momentarily losing track of one's child can be a terrifying experience. Having that occur with a child with ASD could be an incredibly difficult situation because skill deficits may delay retrieval (Carlile et al., 2018). Proactive teaching of safety skills is important for any individual with ASD but especially for individuals with TRPB.

One such target skill is seeking help from other adults when separated from caregivers. Researchers have taught a variety of help-seeking topographies to individuals with ASD, such as leveraging technology to contact caregivers (e.g., Carlile et al., 2018; Taylor et al., 2004) to recruiting nearby adults for assistance (e.g., Bergstrom et al., 2012; Carlile et al., 2018). For example, Bergstrom et al. (2012) used a treatment package consisting of rules, role play, and praise to teach three children with ASD a sequence of help-seeking behavior. This sequence consisted of calling out for the child's caregivers (e.g., "Mom!") and then identifying a store employee and informing them of being lost. This approach was effective at teaching help-seeking behavior, with extension of teaching effects to untaught locations. In a more recent example, Carlile et al. used a video-modeling package to teach multiple help-seeking topographies to six children with ASD. Similar to Bergstrom et al., the authors taught the children to seek out an adult but then hand over an identification card. Additionally, children in this study acquired the skill of contacting their caregivers using a video-call application on a cell phone. Both interventions, conducted initially in a school setting, maintained across weeks and extended to untaught situations and settings. Children with ASD also may be at increased risk of dangers like abduction when in the community (Abadir et al., 2021). Researchers have used strategies such as video modeling and behavioral skills training to teach abduction-prevention skills to children with ASD (Abadir et al., 2021; Berube et al., 2021). For example, Berube et al. taught children to say "No" and leave the area following a lure attempt and Abadir et al. taught children to request a code word from the individual before accompanying them. We encourage behavior analysts to consider this literature and tailor safety skills to the client's repertoire and the family's resources (e.g., availability of technology) should TRPB ever result in separation from caretakers.

Conclusion

In this chapter, we provided an overview of how to safely assess and treat challenging behavior associated with transitions. As we discussed, these transitions may incorporate more than just physical movement from one point to another; instead, transitions can be viewed as when environmental conditions change, with such resistance to change being a hallmark of ASD. We provided a description of how these sorts of transitions can be evaluated within a functional analysis and to do so with maximum safety when assessing TRPB like elopement. There are many treatment approaches with empirical support, including NCR, DRO, DRA, and FCT. We encourage researchers to conduct more within-subject comparisons of treatment options for TRPB to understand each intervention's relative efficacy. For now, we urge behavior analysts to consult with the individual with ASD, their stakeholders, and the dynamic literature base to determine the ideal treatment arrangement for each client. Finally, for all individuals with TRPB and especially those with risky topographies like elopement, teaching safety skills and assisting caregivers in locating safety resources (e.g., GPS trackers) will be important components of a larger approach to treatment.

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References

Abadir, C. M., DeBar, R. M., Vladescu, J. C., Reeve, S. A., & Kupferman, D. M. (2021). Effects of video modeling on abduction-prevention skills by individuals with autism spectrum disorder. *Journal of Applied Behavior Analysis, 54*(3), 1139–1156. https://doi.org/10.1002/jaba.822

Allen, K. D., & Warzak, W. J. (2000). The problem of parental nonadherence in clinical behavior analysis: Effective treatment is not enough. *Journal of Applied Behavior Analysis, 33*(3), 373–391. https://doi.org/10.1901/jaba.2000.33-373

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Andersen, A. M., Law, J. K., Marvin, A. R., & Lipkin, P. H. (2020). Elopement patterns and caregiver strategies. *Journal of Autism and Developmental Disorders, 50*(6), 2053–2063. https://doi.org/10.1007/s10803-019-03961-x

Anderson, C., Law, J. K., Daniels, A., Rice, C., Mandell, D. S., Hagopian, L., & Law, P. A. (2012). Occurrence and family impact of elopement in children with autism spectrum disorders. *Pediatrics, 130*(5), 870–877. https://doi.org/10.1542/peds.2012-0762

Azrin, N. H., Hutchinson, R. R., & Hake, D. F. (1966). Extinction-induced aggression. *Journal of the Experimental Analysis of Behavior, 9*(3), 191–204. https://doi.org/10.1901/jeab.1966.9-191

Banda, D. R., Grimmett, E., & Hart, S. L. (2009). Activity schedules: Helping students with autism spectrum disorders in general education classrooms manage transition issues. *Teaching Exceptional Children*, *41*(4), 16–21. https://doi.org/10.1177/004005990904100402

Bergstrom, R., Najdowski, A. C., & Tarbox, J. (2012). Teaching children with autism to seek help when lost in public. *Journal of Applied Behavior Analysis, 45*(1), 191–195. https://doi.org/10.1901/jaba.2012.45-191

Berube, T., MacDonald, J., & Parry-Cruwys, D. (2021). Teaching abduction prevention skills to children using a one-on-one training setting. *Behavioral Interventions, 36*(3), 550–560. https://doi.org/10.1002/bin.1806

Betz, A. M., Fisher, W. W., Roane, H. S., Mintz, J. C., & Owen, T. M. (2013). A component analysis of schedule thinning during functional communication training. *Journal of Applied Behavior Analysis, 46*(1), 219–241. https://doi.org/10.1002/jaba.23

Blowers, A. P., Rodriguez, N. M., Cohrs, V. L., Luczynski, K. C., & Aragon, M. (2020). Assessment and treatment of elopement maintained by chase. *Behavioral Interventions, 35*(3), 432–445. https://doi.org/10.1002/bin.1729

Boyd, B. A., McDonough, S. G., & Bodfish, J. W. (2012). Evidence-based behavioral interventions for repetitive behaviors in autism. *Journal of Autism and Developmental Disorders, 42*(6), 1236–1248. https://doi.org/10.1007/s10803-011-1284-z

Boyle, M. A., & Adamson, R. M. (2017). Systematic review of functional analysis and treatment of elopement (2000–2015). *Behavior Analysis in Practice, 10*(4), 375–385. https://doi.org/10.1007/s40617-017-0191-y

Boyle, M. A., Keenan, G., Forck, K. L., & Curtis, K. S. (2019). Treatment of elopement without blocking with a child with autism. *Behavior Modification, 43*(1), 132–145. https://doi.org/10.1177/0145445517740871

Call, N. A., Alvarez, J. P., Simmons, C. A., Lomas Mevers, J. E., & Scheithauer, M. C. (2017). Clinical outcomes of behavioral treatments for elopement in individuals with autism spectrum disorder and other developmental disabilities. *Autism, 21*(3), 375–379. https://doi.org/10.1177/1362361316644732

Carlile, K. A., DeBar, R. M., Reeve, S. A., Reeve, K. F., & Meyer, L. S. (2018). Teaching help-seeking when lost to individuals with autism spectrum disorder. *Journal of Applied Behavior Analysis, 51*(2), 191–206. https://doi.org/10.1002/jaba.447

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*(2), 111–126. https://doi.org/10.1901/jaba.1985.18-111

Carr, J. E., Coriaty, S., Wilder, D. A., Gaunt, B. T., Dozier, C. L., Britton, L. N., et al. (2000). A review of "noncontingent" reinforcement as treatment for the aberrant behavior of individuals with developmental disabilities. *Research in Developmental Disabilities, 21*(5), 377–391. https://doi.org/10.1016/S0891-4222(00)00050-0

Colvin, G., Sugai, G., Good, R. H., III, & Lee, Y. Y. (1997). Using active supervision and pre-correction to improve transition behaviors in an elementary school. *School Psychology Quarterly, 12*(4), 344–363. https://doi.org/10.1037/h0088967

Cote, C. A., Thompson, R. H., & McKerchar, P. M. (2005). The effects of antecedent interventions and extinction on toddlers' compliance during transitions. *Journal of Applied Behavior Analysis, 38*(2), 235–238. https://doi.org/10.1901/jaba.2005.143-04

Deshais, M. A., Fisher, A. B., & Kahng, S. (2018). A preliminary investigation of a randomized dependent group contingency for hallway transitions. *Education* *and Treatment of Children, 41*(1), 49–63. https://doi.org/10.1353/etc.2018.0002

Dracobly, J. D., Dozier, C. L., Briggs, A. M., & Juanico, J. F. (2018). Reliability and validity of indirect assessment outcomes: Experts versus caregivers. *Learning and Motivation, 62*, 77–90. https://doi.org/10.1016/j.lmot.2017.02.007

Fisher, W. W., Rodriguez, N. R., Luczynski, K. C., & Kelley, M. E. (2013). The use of protective equipment in the management of severe behavior disorders. In D. D. Reed, F. D. DiGennaro Reed, & J. K. Luiselli (Eds.), *Handbook of crisis intervention and developmental disabilities* (pp. 87–105). Springer Science + Business Media. https://doi.org/10.1007/978-1-4614-6531-7_6

Fisher, W. W., Greer, B. D., & Fuhrman, A. M. (2015a). *Functional communication training. Archives of practitioner resources for applied behavior analysts*. Western Michigan University. Retrieved from https://wmich.edu/autism/resources

Fisher, W. W., Greer, B. D., Fuhrman, A. M., & Querim, A. C. (2015b). Using multiple schedules during functional communication training to promote rapid transfer of treatment effects. *Journal of Applied Behavior Analysis, 48*(4), 713–733. https://doi.org/10.1002/jaba.254

Fisher, W. W., Fuhrman, A. M., Greer, B. D., Mitteer, D. R., & Piazza, C. C. (2020). Mitigating resurgence of destructive behavior using the discriminative stimuli of a multiple schedule. *Journal of the Experimental Analysis of Behavior, 113*(1), 263–277. https://doi.org/10.1002/jeab.552

Flannery, K. B., & Horner, R. H. (1994). The relationship between predictability and problem behavior for students with severe disabilities. *Journal of Behavioral Education, 4*(2), 157–176. https://doi.org/10.1007/BF01544110

Fuhrman, A. M., Fisher, W. W., & Greer, B. D. (2016). A preliminary investigation on improving functional communication training by mitigating resurgence of destructive behavior. *Journal of Applied Behavior Analysis, 49*(4), 884–899. https://doi.org/10.1002/jaba.338

Ghaemmaghami, M., Hanley, G. P., & Jessel, J. (2016). Contingencies promote delay tolerance. *Journal of Applied Behavior Analysis, 49*(3), 548–575. https://doi.org/10.1002/jaba.333

Greer, B. D., Fisher, W. W., Saini, V., Owen, T. M., & Jones, J. K. (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. *Journal of Applied Behavior Analysis, 49*(1), 105–121. https://doi.org/10.1002/jaba.265

Greer, B. D., Mitteer, D. R., & Fisher, W. W. (2018). A practical approach to functional communication training. In A. C. Sella & D. M. Ribeiro (Eds.), *Behavior analysis applied to autism spectrum disorders*. Appris.

Guan, J., & Li, G. (2017). Injury mortality in individuals with autism. *American Journal of Public Health, 107*(5), 791–793. https://doi.org/10.2105/AJPH.2017.303696

Haddock, J. N., & Hagopian, L. P. (2020). Competing stimulus assessments: A systematic review. *Journal of Applied Behavior Analysis, 53*(4), 1982–2001. https://doi.org/10.1002/jaba.754

Hagopian, L. P. (2020). The consecutive controlled case series: Design, data-analytics, and reporting methods supporting the study of generality. *Journal of Applied Behavior Analysis, 53*(2), 596–619. https://doi.org/10.1002/jaba.691

Hangen, M. M., Romero, A. N., Neidert, P. L., & Borrero, J. C. (2020). "Other" behavior and the DRO: The roles of extinction and reinforcement. *Journal of Applied Behavior Analysis, 53*(4), 2385–2404. https://doi.org/10.1002/jaba.736

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis, 34*(1), 17–38. https://doi.org/10.1901/jaba.2001.34-17

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47*(1), 16–36. https://doi.org/10.1002/jaba.106

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. (Reprinted from Analysis and Intervention in Developmental Disabilities, 2(1), 3–20, 1982). https://doi.org/10.1901/jaba.1994.27-197

Jessel, J., Hanley, G. P., & Ghaemmaghami, M. (2016). A translational evaluation of transitions. *Journal of Applied Behavior Analysis, 49*(2), 359–376. https://doi.org/10.1002/jaba.283

Jessel, J., Ingvarsson, E. T., Metras, R., Kirk, H., & Whipple, R. (2018). Achieving socially significant reductions in problem behavior following the interview-informed synthesized contingency analysis: A summary of 25 outpatient applications. *Journal of Applied Behavior Analysis, 51*(1), 130–157. https://doi.org/10.1002/jaba.436

Joseph, L., Thurm, A., Farmer, C., & Shumway, S. (2013). Repetitive behavior and restricted interests in young children with autism: Comparisons with controls and stability over 2 years. *Autism Research, 6*(6), 584–595. https://doi.org/10.1002/aur.1316

Jwaideh, A. R., & Mulvaney, D. E. (1976). Punishment of observing by a stimulus associated with the lower of two reinforcement frequencies. *Learning and Motivation, 7*(2), 211–222. https://doi.org/10.1016/0023-9690(76)90029-1

Kamlowsky, M. E., Wilder, D. A., Ertel, H., Hodges, A. C., Colon, N., & Domino, L. (2021). Latency-based functional analysis and treatment of elopement. *Behavioral Interventions, 36*(2), 329–341. https://doi.org/10.1002/bin.1781

Kiely, B., Migdal, T. R., Vettam, S., & Adesman, A. (2016). Prevalence and correlates of elopement in a nationally representative sample of children with

developmental disabilities in the United States. *PLoS One, 11*(2), e0148337. https://doi.org/10.1371/journal.pone.0148337
Kirkwood, C. A., Piazza, C. C., & Peterson, K. M. (2021). A comparison of function-and nonfunction-based extinction treatments for inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 54*(3), 928–945. https://doi.org/10.1002/jaba.825
Knight, V., Sartini, E., & Spriggs, A. D. (2015). Evaluating visual activity schedules as evidence-based practice for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 45*(1), 157–178. https://doi.org/10.1007/s10803-014-2201-z
Kuhn, D. E., DeLeon, I. G., Fisher, W. W., & Wilke, A. E. (1999). Clarifying an ambiguous functional analysis with matched and mismatched extinction procedures. *Journal of Applied Behavior Analysis, 32*(1), 99–102. https://doi.org/10.1901/jaba.1999.32-99
Lalli, J. S., Vollmer, T. R., Progar, P. R., Wright, C., Borrero, J., Daniel, D., et al. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis, 32*(3), 285–296. https://doi.org/10.1901/jaba.1999.32-285
Lam, K. S. L., & Aman, M. G. (2007). The repetitive behavior scale-revised: Independent validation in individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*(5), 855–866. https://doi.org/10.1007/s10803-006-0213-z
Langford, J. S., Pitts, R. C., & Hughes, C. E. (2019). Assessing functions of stimuli associated with rich-to-lean transitions using a choice procedure. *Journal of the Experimental Analysis of Behavior, 112*(1), 97–110. https://doi.org/10.1002/jeab.540
Langford, J. S., Batchelder, S. R., Haste, D. A., Thuman, E. P., Pitts, R. C., & Hughes, C. E. (2021). Effects of chlordiazepoxide on pausing during rich-to-lean transitions. *Journal of the Experimental Analysis of Behavior, 116*(1), 3–20. https://doi.org/10.1002/jeab.703
Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*(3), 407–414. https://doi.org/10.1901/jaba.2003.36-407
Leekam, S. R., Prior, M. R., & Uljarevic, M. (2011). Restricted and repetitive behaviors in autism spectrum disorders: A review of research in the last decade. *Psychological Bulletin, 137*(4), 562–593. https://doi.org/10.1037/a0023341
Lehardy, R. K., Lerman, D. C., Evans, L. M., O'Conner, A., & LeSage, D. L. (2013). A simplified methodology for identifying the function of elopement. *Journal of Applied Behavior Analysis, 46*(1), 256–270. https://doi.org/10.1002/jaba.22
Lequia, J., Machalicek, W., & Rispoli, M. J. (2012). Effects of activity schedules on challenging behavior exhibited in children with autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 6*(1), 480–492. https://doi.org/10.1016/j.rasd.2011.07.008
Luczynski, K. C., & Rodriguez, N. M. (2015). Assessment and treatment of problem behavior associated with transitions. In F. D. DiGennaro Reed & D. D. Reed (Eds.), *Autism service delivery: Bridging the gap between science and practice* (pp. 151–173). Springer. https://doi.org/10.1007/978-1-4939-2656-5_5
MacNaul, H. L., & Neely, L. C. (2018). Systematic review of differential reinforcement of alternative behavior without extinction for individuals with autism. *Behavior Modification, 42*(3), 398–421. https://doi.org/10.1177/2F0145445517740321
McCord, B. E., Thomson, R. J., & Iwata, B. A. (2001). Functional analysis and treatment of self-injury associated with transitions. *Journal of Applied Behavior Analysis, 34*(2), 195–210. https://doi.org/10.1901/jaba.2001.34-195
McLaughlin, L., Rapoport, E., Keim, S. A., & Adesman, A. (2020). Wandering by children with autism spectrum disorders: Impact of electronic tracking devices on elopement behavior and quality of life. *Journal of Developmental & Behavioral Pediatrics, 41*(7), 513–521. https://doi.org/10.1097/DBP.0000000000000591
Mitteer, D. R., Randall, K. R., Van Winkle, L. J., & Greer, B. D. (2020). Incorporating discriminative stimuli into functional communication training with augmentative and alternative communication devices: A tutorial. *Augmentative and Alternative Communication, 36*(1), 63–70. https://doi.org/10.1080/07434618.2020.1731761
Mulvaney, D. E., Dinsmoor, J. A., Jwaideh, A. R., & Hughes, L. H. (1974). Punishment of observing by the negative discriminative stimulus. *Journal of the Experimental Analysis of Behavior, 21*(1), 37–44. https://doi.org/10.1901/jeab.1974.21-37
National Autism Association. (2014). Big red safety toolkit: A digital resource for caregivers. Retrieved from http://nationalautismassociation.org/docs/BigRedSafetyToolkit.pdf
Neil, N., & Sturmey, P. (2014). Assessment and treatment of obsessions and compulsions in individuals with autism spectrum disorders: A systematic review. *Review Journal of Autism and Developmental Disorders, 1*(1), 62–79. https://doi.org/10.1007/s40489-013-0006-1
Perone, M. (2003). Negative effects of positive reinforcement. *The Behavior Analyst, 26*(1), 1–14. https://doi.org/10.1007/bf03392064
Perone, M., & Courtney, K. (1992). Fixed-ratio pausing: Joint effects of past reinforcer magnitude and stimuli correlated with upcoming magnitude. *Journal of the Experimental Analysis of Behavior, 57*(1), 33–46. https://doi.org/10.1901/jeab.1992.57-33
Phillips, L. A., Briggs, A. M., Fisher, W. W., & Greer, B. G. (2018). Assessing and treating elopement in a school setting. *Teaching Exceptional Children, 50*(6), 333–342. https://doi.org/10.1177/0040059918770663
Piazza, C. C., Hanley, G. P., Bowman, L. G., Ruyter, J. M., Lindauer, S. E., & Saiontz, D. M. (1997). Functional analysis and treatment of elopement. *Journal of*

Applied Behavior Analysis, 30(4), 653–672. https://doi.org/10.1002/jaba.376

Pitts, R. C., Hughes, C. E., & Williams, D. C. (2019). Transitions from rich-to-lean schedules increase attack in a laboratory model of social aggression in pigeons: II. Fixed-interval schedules. *Mexican Journal of Behavior Analysis, 45*(2), 519–546. https://doi.org/10.5514/rmac.v45.i2.75582

Rajaraman, A., Hanley, G. P., Gover, H. C., Staubitz, J. L., Staubitz, J. E., Simcoe, K. M., & Metras, R. (2022). Minimizing escalation by treating dangerous problem behavior within an enhanced choice model. *Behavior Analysis in Practice, 15*(1), 219–242. https://doi.org/10.1007/s40617-020-00548-2

Richler, J., Huerta, M., Bishop, S. L., & Lord, C. (2010). Developmental trajectories of restricted and repetitive behaviors and interests in children with autism spectrum disorders. *Development and Psychopathology, 22*(1), 55–69. https://doi.org/10.1017/S0954579409990265

Rooker, G. W., Jessel, J., Kurtz, P. F., & Hagopian, L. P. (2013). Functional communication training with and without alternative reinforcement and punishment: An analysis of 58 applications. *Journal of Applied Behavior Analysis, 46*(4), 708–722. https://doi.org/10.1002/jaba.76

Rooker, G. W., Bonner, A. C., Dillon, C. M., & Zarcone, J. R. (2018). Behavioral treatment of automatically reinforced SIB: 1982–2015. *Journal of Applied Behavior Analysis, 51*(4), 974–997. https://doi.org/10.1002/jaba.492

Rose, J. C., & Beaulieu, L. (2019). Assessing the generality and durability of interview-informed functional analyses and treatment. *Journal of Applied Behavior Analysis, 52*(1), 271–285. https://doi.org/10.1002/jaba.504

Rutherford, M., Baxter, J., Grayson, Z., Johnston, L., & O'Hare, A. (2020). Visual supports at home and in the community for individuals with autism spectrum disorders: A scoping review. *Autism, 24*(2), 447–469. https://doi.org/10.1177/1362361319871756

Saini, V., Miller, S. A., & Fisher, W. W. (2016). Multiple schedules in practical application: Research trends and implications for future investigation. *Journal of Applied Behavior Analysis, 49*(2), 421–444. https://doi.org/10.1002/jaba.300

Saini, V., Ubdegrove, K., Biran, S., & Duncan, R. (2020). A preliminary evaluation of interrater reliability and concurrent validity of open-ended indirect assessment. *Behavior Analysis in Practice, 13*(1), 114–125. https://doi.org/10.1007/s40617-019-00364-3

Schmit, J., Alper, S., Raschke, D., & Ryndak, D. (2000). Effects of using a photographic cueing package during routine school transitions with a child who has autism. *Mental Retardation, 38*(2), 131–137. https://doi.org/10.1352/0047-6765(2000)038<0131:EOUAPC>2.0.CO;2

Schreibman, L., Whalen, C., & Stahmer, A. C. (2000). The use of video priming to reduce disruptive transition behavior in children with autism. *Journal of Positive Behavior Interventions, 2*(1), 3–11. https://doi.org/10.1177/2F109830070000200102

Taylor, B. A., Hughes, C. E., Richard, E., Hoch, H., & Rodriquez Coello, A. (2004). Teaching teenagers with autism to seek assistance when lost. *Journal of Applied Behavior Analysis, 37*(1), 79–82. https://doi.org/10.1901/jaba.2004.37-79

Taylor-Greene, S., Brown, D., Nelson, L., Longton, J., Gassman, T., Cohen, J., Swartz, J., Horner, R. H., Sugai, G., & Hall, S. (1997). School-wide behavioral support: Starting the year off right. *Journal of Behavioral Education, 7*(1), 99–112. https://doi.org/10.1023/A:1022849722465

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*(1), 16–23. https://doi.org/10.1007/BF03391716

Toegel, F., & Perone, M. (2022). Effects of advance notice on transition-related pausing in pigeons. *Journal of the Experimental Analysis of Behavior, 117*(1), 3–19. https://doi.org/10.1002/jeab.730

Trump, C. E., Ayres, K. M., Quinland, K. K., & Zabala, K. A. (2020). Differential reinforcement without extinction: A review of the literature. *Behavior Analysis: Research and Practice, 20*(2), 94–107. https://doi.org/10.1037/bar0000169

Varni, J. W., Lovaas, O. I., Koegel, R. L., & Everett, N. L. (1979). An analysis of observational learning in autistic and normal children. *Journal of Abnormal Child Psychology, 7*(1), 31–43. https://doi.org/10.1007/BF00924508

Vollmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities, 13*(4), 393–417. https://doi.org/10.1016/0891-4222(92)90013-V

Wade-Galuska, T., Perone, M., & Wirth, O. (2005). Effects of past and upcoming response-force requirements on fixed-ratio pausing. *Behavioural Processes, 68*(1), 91–95. https://doi.org/10.1016/j.beproc.2004.10.001

Waters, M. B., Lerman, D. C., & Hovanetz, A. N. (2009). Separate and combined effects of visual schedules and extinction plus differential reinforcement on problem behavior occasioned by transitions. *Journal of Applied Behavior Analysis, 42*(2), 309–313. https://doi.org/10.1901/jaba.2009.42-309

Williams, D. C., Saunders, K. J., & Perone, M. (2011). Extended pausing by humans on multiple fixed-ratio schedules with varied reinforcer magnitude and response requirements. *Journal of the Experimental Analysis of Behavior, 95*(2), 203–220. https://doi.org/10.1901/jeab.2011.95-203

Williams, D. C., Hayashi, Y., Brewer, A., Saunders, K. J., Fowler, S., & Pitts, R. C. (2019). Transitions from rich-to-lean schedules increase attack in a laboratory model of social aggression in pigeons: I. Fixed-ratio schedules. *Mexican Journal of Behavior Analysis, 45*(2), 500–518. https://doi.org/10.5514/rmac.v45.i2.75580

Wing, L., & Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: Epidemiology and classification. *Journal of Autism and Developmental Disorders, 9*(1), 11–29. https://doi.org/10.1007/BF01531288

14 Self-Injury

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Contents

Introduction

One of the most perplexing and challenging forms of behavior in autism spectrum disorder (ASD) is self-injury. Self-injurious behavior (SIB) has been reported in clinical documentation and in the research literature to take various forms including self-hitting, head banging, self-pinching, self-scratching, eye-gouging, self-kicking, hair-pulling, self-biting, and many others. There are also other, more discrete forms of behavior that are self-injurious, such as aerophagia (i.e., swallowing air; Holburn, 1986), chronic hand mouthing (Roscoe et al., 2013), and bruxism (teeth-grinding; Lang et al., 2009).

Of course, not all individuals with ASD display SIB, but the problem is significant in that population. For example, Steenfeldt-Kristensen et al. (2020) conducted a meta-analysis of published studies reporting prevalence of SIB. Of the 14,379 participants across 37 reports, 42% engaged in some form of SIB. The prevalence statistics vary widely in different studies, but all suggest that the problem is far greater in ASD

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than in the general population (Dominick et al., 2007).

Although SIB is commonly described as highly repetitive behavior that can occur at frequencies of up to dozens of instances per minute (Iwata et al., 1994a), the behavior also can be episodic insofar as it either occurs under highly specific stimulus contexts or in bursts after long periods without problematic behavior (e.g., O'Reilly, 1997). A majority of the evidence suggests that SIB is learned behavior that is often inadvertently reinforced by common social consequences to the behavior, such as attention from adults, access to preferred items or activities, or escape from instructional or undesired activities. Sometimes the behavior occurs because it produces stimulation by itself (e.g., Piazza et al., 2000) and, therefore, will persist in the absence of social reinforcement (a phenomenon known as "automatic reinforcement," Skinner, 1953; Vaughan & Michael, 1982).

In this chapter, updated from Vollmer et al. (2009), we will first describe the known "operant functions" of SIB. Second, we will describe behavioral assessment methods for SIB. Third, we will describe how the assessment information can be used to initiate behavioral treatments. Not all of the examples used will come directly from participants with ASD, but the same or similar principles apply.

Origin and Maintenance of SIB

For the past several decades, research on functional analysis and treatment of SIB have shown that such behavior is often maintained via operant reinforcement contingencies, and that the learning history produced by reinforcement can be overridden by new contingencies during treatment (Iwata et al., 1994b; Hagopian et al., 1998). These operant contingencies include social positive reinforcement, social negative reinforcement, and automatic reinforcement. There is also evidence to suggest that a subset of SIB is primarily controlled by antecedent variables.

Some SIB is maintained by socially mediated positive reinforcement. *Socially mediated* means only that the reinforcement is delivered by another person. *Positive* means that some stimulation is *presented* as a consequence to behavior. *Reinforcement* means *to strengthen* (in the sense that behavior is more likely to occur under similar circumstances in the future). Of course, few care providers would intentionally reinforce SIB, but many natural reactions from the social environment inadvertently produce a reinforcement effect. Socially mediated reinforcement can be in the form of reprimands, comfort statements, or physical proximity (Iwata et al., 1994b) or can be tangible items such as food, toys, or activities. It is a very common and perhaps even a natural adult response to reprimand, comfort, or try to calm down an individual when severe behavior occurs (e.g., Thompson & Iwata, 2001), and probably, the adult's behavior is, in turn, reinforced by the temporary cessation of SIB (Miller et al., 2010; Sloman et al., 2005). Additionally, it is often impossible to ignore behavior that is severe; safety considerations might require the deliberate reinforcement of SIB.

Some SIB is maintained by socially mediated negative reinforcement, also known as escape and avoidance. Again, *socially mediated* means that it is delivered by another person. *Negative* means that some stimulation is *removed, terminated, or avoided* as a consequence to behavior. *Reinforcement* again means *to strengthen* (increase the future likelihood of) the behavior. Thus, the distinction between socially mediated positive reinforcement and socially mediated negative reinforcement is that in the latter, aversive stimulation is essentially "turned off" when SIB occurs. For example, a care provider might make a request to complete an academic or self-care activity but then stop making requests when SIB occurs (e.g., "okay, we'll do that later"). As with positive reinforcement, such a reaction by a teacher, parent, or other care provider is not intended to reinforce the behavior. Rather, the care provider's termination of instructions or demands is probably reinforced by the temporary cessation of SIB. The problem is that the SIB becomes more likely to occur in similar situations in the future. Socially mediated negative reinforcement is not limited to escape from instructions or demands; removal of any aversive stimulus, such as a loud peer or nonpreferred food, can also reinforce SIB.

Some SIB is not socially reinforced. In these cases, the stimulus products of the behavior can produce either automatic positive or automatic negative reinforcement (Vollmer, 1994). The term *automatic* means the reinforcement is not delivered by another person (Vaughan & Michael, 1982). Thus, behavior maintained by automatic reinforcement is hypothesized to generate its own consequences. Automatic positive reinforcement can occur if the behavior produces some sort of pleasing sensation. Automatic negative reinforcement can occur when the behavior terminates some aversive physical sensation, such as when self-scratching terminates an itching sensation or ear-hitting momentarily alleviates the pain produced by an ear infection (Cataldo & Harris, 1982).

Pain states and states of discomfort are known to interact with reinforcement contingencies, making dangerous behavior (including SIB) more likely. For example, research has shown that severe problem behavior can increase when the individual is experiencing fatigue (Smith et al., 2016), allergy symptoms (Kennedy & Meyer, 1996), menses (Carr et al., 2003), constipation (Christensen et al., 2008), skin irritation (Peine et al., 1995), ear infections (O'Reilly, 1997), and a host of other conditions. Thus, a thorough understanding of the causes of SIB must not only take into account reinforcement but also physiological states that may exacerbate the deleterious effects of reinforcement. For example, Kennedy and Meyer (1996) showed that negatively reinforced SIB was exacerbated when the participants in their study were experiencing allergies. Similarly, O'Reilly (1997) showed that escape behavior was elevated when their participant experienced ear infections.

Although most SIB appears to be sensitive to social positive, social negative, and automatic reinforcement, there is evidence that some forms of SIB may occur under conditions of aversive stimulation or reinforcer loss even if the SIB is not reinforced (Lloveras et al., 2022). In a specific example, Hutchinson (1977) reviewed literature related to biting (self or others) that showed clearly that organisms, including humans, bite on something when presented with loud noise or other aversive stimulation. Similarly, organisms bite (self, others, or objects) when reinforcer delivery is withheld or terminated. According to Hutchinson, this general type of SIB may be related to phylogenetic factors, such as aggressive behavior that is protective. Clearly, when dangerous behavior such as self-biting begins to occur, it is conceivable that it enters into contingencies of reinforcement such as those described previously (e.g., Richman & Lindauer, 2005).

Pre-treatment Considerations for SIB

Before beginning a behavioral assessment, or perhaps during the behavioral assessment, there are several important considerations related to the occurrence of SIB. First, medical professionals should be consulted to evaluate whether self-injury is related in any way to a medical complication, pain, or state of physical discomfort (Bosch et al., 1997). If the root cause of SIB is related to a physiological variable, such as an ear infection or allergies, it is important that a thoroughgoing treatment would address all such variables. It is also possible that medical providers may prescribe medications to treat ailments (e.g., constipation) or other sources of discomfort (e.g., sleep deprivation). During the evaluation process, behavior analysts can assist by using reliable methods of data collection, both to provide objective measurement in their collaborations with other providers and ultimately to help measure treatment effects when a relation between a physiological variable and SIB has been identified.

Practitioners should also consider additional environmental modifications that may minimize injury risks, such as removing hard objects and padding furniture. In some cases, the severity of SIB may necessitate personal protective equipment such as helmets, arm guards, and gloves. Protective equipment may reduce the overall severity of SIB but also presents several potential drawbacks. Protective equipment that limits motor movement has been associated with physiological side effects such as restricted range of motion, adverse effects on muscles and tendons, as well as bone degradation (e.g., Fisher et al., 1997). Thus, a careful balance between these negative side effects and client protection requires diligence and often coordinated efforts with a professional team. Additionally, in some cases, the protective equipment comes to function as a positive reinforcer for SIB and behavioral escalations may occur when the equipment is removed (e.g., Kahng et al., 2008). In these cases, practitioners must carefully weigh the benefits and drawbacks and plan for systematic fading of access to protective equipment as SIB is decreased. Protective equipment should not be viewed as an intervention per se, but rather as a possible necessity to ensure safety while a biobehavioral intervention is established.

Other safety precautions should be considered. Some aspects of behavioral assessment, such as functional analyses (discussed below), rely on being able to evoke SIB and, therefore, should not be conducted if SIB would cause immediate danger to the participant, such as in the case of pica (ingestion of inedible objects), blows to the head or eyes, or scratching that produces bleeding. Behavior-analytic services can be provided in a wide range of settings, but not all settings are equipped with the resources to support safe implementation of procedures to evaluate and treat SIB. For example, it might be safe to conduct a functional analysis of head banging in a hospital, where padding, helmets, and medical staff are readily available, but unsafe to conduct a functional analysis of head banging in a classroom at a school, where resources are more limited and dangerous materials may put an individual at risk (such as glass windows). During assessment and treatment sessions, medical personnel should also be consulted related to session-termination criteria. For example, some assessment sessions are terminated when a specific number of self-injurious responses have occurred, or when tissue damage is incurred (e.g., Lerman et al., 1994). When the individual's safety is at risk, and de-escalation techniques have been ineffective, crisis intervention programs may be required. Crisis intervention is distinct from behavioral intervention programs and generally involves physical management, sometimes including brief restraint, for the sole purpose of preventing the individual from further causing damage to themselves (Reed et al., 2013). These techniques should only be implemented by highly trained staff with ongoing supervision. Similar to protective equipment, crisis intervention programs are not a replacement for comprehensive medical or behavioral intervention and should not be implemented long-term (Reed et al., 2013; Vollmer et al., 2011).

Behavioral Assessment of SIB

Indirect Assessment

Indirect assessment refers to methods used to gather information about the target behavior via questionnaire or interview. During indirect assessments, informants are asked to provide descriptions of the behavior and information about common environmental events surrounding the target behavior. There are numerous indirect assessment formats available ranging from informal interviews to more structured interviews (e.g., O'Neill et al., 1997), questionnaires (e.g., Matson & Vollmer, 1995), and rating scales (e.g., Durand & Crimmins, 1988).

Generally, informants are asked about the environmental variables that co-occur with SIB. For example, in the Functional Analysis Screening Tool (FAST), informants are asked to provide a description of the topography, severity and frequency of the behavior, times when the behavior is most and least likely to occur, and "yes or no" answers to a series of questions (e.g., "Does the problem behavior occur when the person is asked to perform a task or to participate in activities?").

Indirect assessments are a useful component of any comprehensive behavioral assessment as they initiate a dialogue between the therapist and caregivers and provide a forum to collect preliminary information about SIB. For example, indirect assessments can help in the development of objective descriptions of the target behavior (operational definitions) along with information about the frequency and severity of the SIB. Indirect assessments can also help identify potential medical or environmental variables that might affect either the specific function of SIB (e.g., menses might increase the likelihood of escape maintained problem behavior; Carr et al., 2003) or the rate of SIB more generally (e.g., sleep deprivation; Kennedy & Meyer, 1996). Other benefits of indirect assessments are that they can be administered relatively quickly (e.g., 15–20 min) and they require little training to conduct. Furthermore, indirect assessments may elucidate information about topographies that are not amenable to direct assessment methods. This may include behavior that occurs too infrequently to be reliably observed through direct assessment methods, covert SIB such as skin picking that occurs in the absence of other people, or responses that cannot be allowed to occur due to the severity of behavior (e.g., head banging against sharp objects, eye-gouging). Indirect assessments may provide a starting point to inform subsequent assessment components (e.g., descriptive and functional analyses) and may also provide an alternative when direct assessments cannot be conducted. However, in most cases, it is recommended that indirect assessments should not be used as the sole means to acquire information about SIB because they do not directly identify functional relations. Also, informant reports are widely known to be unreliable when indirect assessments are used to evaluate severe behavior (Roscoe et al., 2015). Thus, indirect assessments should be supplemented with direct assessment measures when possible.

Descriptive Analysis

Descriptive analysis (DA) refers to the direct observation of behavior during natural contexts (Bijou et al., 1968). During DAs, data are collected on the frequency or duration of the target behavior and surrounding antecedent and consequent events. However, as with indirect assessments, no systematic manipulation of consequences is made. Data gathered during DAs may provide necessary information for general assessment or treatment evaluation purposes such as operational definitions of behavior, baseline levels of responding, and potentially relevant environmental events. Another potential benefit of DA methods for SIB specifically is that direct observations of the topography might not only inform investigations of function but root cause as well. For example, if SIB is targeted at the jaw or mouth, it may be likely that the individual is experiencing dental pain that should be investigated. Similar considerations could be made for SIB directed at the ears (e.g., ear infections), stomach (e.g., gastrointestinal issues), or even head (e.g., headaches). Furthermore, DAs can be used to identify potential cyclical patterns in SIB that could be related to bio-behavioral factors such as allergies or menses (Carr & Smith, 1995).

The major limitation of DA methods is that a functional relation cannot be determined because consequences are not manipulated. For example, St. Peter et al. (2005) conducted functional analyses for four participants and found that attention was not a reinforcer for problem behavior for any of the participants. However, St. Peter et al. then used DAs to examine relations between attention and problem behavior and found that the delivery of attention was highly correlated with problem behavior for all participants. Thus, DA methods often indicate a relation between occurrence of problem behavior and the occurrence of attention, but that does not necessarily mean that attention is the reinforcer for the problem behavior. Additionally, several studies have compared the results from descriptive and functional analyses and found that often they do not correspond (see Contreras et al., in press, for literature review). Thus, DAs are generally determined to be inappropriate as a sole means of hypothesizing functional relations for SIB.

Despite limitations, DAs may inform functional analyses and treatments. For example, direct observation can improve operational definitions of behavior and provides information on the naturally occurring rates of behavior (i.e., a baseline), which can later be used to assess treatment effects. They may also help to identify idiosyncratic events related to behavior (e.g., Schlichenmeyer et al., 2013), such as specific instructional demands associated with the behavior, or specific tangible or attention-related consequences. Furthermore, direct observation may provide useful information when functional analyses cannot be conducted safely. Descriptive analyses can also be used to identify precursors to more severe forms of behavior (Borrero & Borrero, 2008). These precursors identified via DAs can subsequently be reinforced, in lieu of SIB, in a functional analysis.

Functional Analyses

A functional analysis generally refers to the manipulation of variables to determine cause and effect relations. However, in the realm of contemporary applied behavior analysis, functional analysis usually refers to a specific assessment procedure used to identify reinforcers maintaining problem behavior (Iwata et al., 1994a). During a functional analysis, consequences are isolated and manipulated contingent on problem behavior to identify functional relations. Although the intentional delivery of potentially reinforcing events may seem counterintuitive, this approach is analogous to allergy testing, during which patients are exposed to various allergens to determine an effective course of treatment. During functional analyses, participants are exposed to analogs of situations they commonly experience in everyday life to determine an effective course of treatment. Functional analysis offers advantages over indirect and descriptive methods because the information gathered is not correlational. Thus, functional analyses may prevent the implementation of ineffective treatments or treatments that are contraindicated (e.g., Iwata et al., 1994b).

A commonly used functional analysis procedure was first described by Iwata et al. (1994a). The general procedures involved alternating the presentation of three test conditions and one control condition repeatedly in a multielement experimental design until clear outcomes were obtained. The purpose of the control condition was to create a situation in which SIB was unlikely to occur. That is, the participant was given free access to preferred items, the therapist provided attention intermittently, and no demands were placed on the participant. Differentially higher rates in the test conditions relative to the control condition were used to indicate a reinforcement effect. The test conditions in Iwata, Dorsey et al. included social attention, demand, and alone. In many current applications, another condition typically called "tangible" is included when necessary (Rooker et al., 2011).

The most common test conditions are alone/no interaction, attention, tangible, and escape (Beavers et al., 2013). Attention and tangible conditions test whether SIB is maintained by social positive reinforcement; a tangible or attention is initially withheld and only delivered contingent on SIB. The purpose of the escape condition is to test if behavior is maintained by socially mediated negative reinforcement in the form of escape, usually from instructional demands. The therapist presents the aversive stimuli (e.g., demands) and only removes them contingent on SIB. Differentially higher rates of SIB in these test conditions relative to the control condition indicate that SIB is reinforced by either access to attention, access to tangibles, escape from demands, or a combination.

The purpose of the alone or no-interaction condition is to test if behavior is sensitive to nonsocially mediated or automatic reinforcement. More specifically, this condition is used to evaluate whether SIB persists in the absence of social consequences. During the alone condition, the participant is left alone in the room and observed through a one-way mirror. During the no-interaction variation, the individual remains in the room with the therapist who provides no programmed consequences for SIB. Differentially higher rates of SIB in the alone or no consequence condition relative to the control condition indicate that SIB is automatically reinforced.

There are special considerations to consider when SIB is maintained by automatic reinforcement. Although high rates across all of the test and control conditions may in some cases indicate that SIB is automatically reinforced because automatic reinforcement is available during any condition, there are other patterns that emerge. Thus, the pattern of responding in functional analyses can provide information about what treatment components may be necessary, which is discussed in the treatment section of this chapter. For example, Hagopian et al. (2015) analyzed functional analysis data for 39 individuals with SIB maintained by automatic reinforcement and identified three main subtypes of responding. Individuals with automatically reinforced SIB in subtype 1 engaged in the highest rates of SIB in the no-interaction condition and lowest rates of SIB in the play condition. For subtype 2, individuals engaged in high rates across all conditions. Patterns of behavior in subtype 3 resembled patterns in subtype 2, but SIB was accompanied by self-restraint (e.g., sitting on hands, putting arms inside of clothing).

When conducting functional analyses of SIB, several important considerations should be addressed. First, it should be determined whether the behavior is amenable to a functional analysis. Standard functional analyses should not be conducted if the behavior is classified as a restricted operant. For example, the probability of emesis (i.e., vomiting) decreases following the first instance, and thus within-session consequences designed to reinforce it may not produce a reinforcement effect. Relatedly, because clear functional analysis outcomes rely on at least moderate rates of behavior to assess relations between behavior and environmental events, functional analyses may be less useful for extremely low-rate SIB. In these cases, other assessment formats or variations of the standard functional analysis procedure should be used. Some limitations of functional analyses have been discussed in the literature, such as that they (a) require a specialized setting, (b) are time consuming and (c) are complicated to conduct (Roscoe et al., 2015). However, many variations in functional analysis have been developed to address these issues (e.g., brief functional analysis, evaluations of within-session responding, Querim et al., 2013). For more information on these variations, refer to Chap. 5 of this book.

Another consideration for the development of a functional analysis as an assessment component is that such an analysis may be inappropriate for some forms of behavior. For example, functional analyses may be inappropriate for behavior that causes an immediate danger to the participant, or behavior that occurs too infrequently to reliably observe. Variations in the standard functional analysis method have been proposed to address these limitations. For severe and dangerous forms of behavior, some researchers have suggested assessing less severe forms of precursor behavior that reliably precede SIB. For example, Smith and Churchill (2002) identified precursors for four individuals who engaged in SIB. They conducted functional analyses of both the precursor behavior and SIB and showed that the functions of the precursor behavior corresponded with the function of SIB. Other variations of functional analyses have been used to address the problem of low-rate behavior by increasing the duration of the test conditions from 10–15 to 45–60 min (Kahng et al., 2001).

In summary, functional analysis is considered standard in the behavioral assessment of SIB. Furthermore, previous research has shown that typical functional analysis procedures may be adapted to accommodate time constraints and other previously cited limitations. Functional analysis research or individualized functional analyses provide a direct link between assessment and treatment development.

Behavioral Treatment

When variables related to the occurrence of SIB have been identified, effective treatments can be developed. Function-based treatments that are designed to reduce SIB involve three primary components of intervention: antecedent or preventive environmental modifications, use of reinforcement to increase appropriate alternative skills, and consequence-based strategies (e.g., minimizing reinforcers for SIB, punishment procedures if reinforcement-based strategies alone are ineffective). Below we discuss treatment studies that usually isolate one of these components. However, comprehensive, ethical, and effective treatments should aim to include multiple components.

Antecedent Interventions

Broadly, antecedent interventions are designed to arrange the environment to reduce the likelihood that target behavior occurs in the first place. These interventions often involve altering the environment to increase access to reinforcers and reduce or modify aversive stimuli that may evoke SIB. For example, if a student's SIB is evoked in the context of academic tasks in the classroom, some examples of antecedent interventions are physical alterations of the classroom to reduce noise (e.g., Kettering et al., 2018), instructional modifications to ensure work is at student's skill level (Reed et al., 2010), and choice of activities when possible (e.g., Humenik et al., 2008).

Another commonly used antecedent intervention is noncontingent reinforcement (NCR), or the time-based presentation of reinforcers independent of behavior (Carr et al., 2000). Noncontingent reinforcement decreases the occurrence of the target behavior by reducing the establishing operation controlling behavior (e.g., caregiver attention is already freely available, so there is less need to engage in SIB to get attention). Noncontingent reinforcement also weakens the contingency between the target response and reinforcer delivery, and (if SIB no longer produces the functional reinforcer) ensures that there is no programmed relation between the problem behavior and reinforcer delivery (Thompson & Iwata, 2005).

The NCR approach is commonly implemented using reinforcers identified via a functional analysis. In the treatment of severe SIB maintained by social positive reinforcement in the form of attention or tangibles, NCR involves the delivery of attention or tangibles continuously or at times independent of behavior (e.g., Vollmer et al., 1993). In the treatment of SIB maintained by social negative reinforcement in the form of escape from academic demands, NCR may involve providing brief escape from tasks at set intervals (e.g., a 30-s break every 2 min; e.g., Vollmer et al., 1995) or "free" positive reinforcers designed to reduce the aversiveness of the instructional activity (Lomas et al., 2010).

The NCR approach has also been shown to reduce socially reinforced SIB even when arbitrary or alternative reinforcers were used ("arbitrary" only in the sense that they were not the maintaining reinforcer for SIB). For example, if SIB is reinforced by access to attention, a caregiver may provide noncontingent access to alternative preferred tangible items. Similarly, if SIB is reinforced by escape from demands, providing alternative reinforcers such as preferred edibles or access to music during that demand period may reduce the SIB (e.g., Lomas et al., 2010). Phillips et al. (2017) analyzed 27 applications of NCR in the treatment of severe problem behavior. Notably, when the authors compared the effectiveness of functional vs. alternative reinforcers in NCR, results showed comparable reductions for socially reinforced problem behavior. Furthermore, a common and practical goal of behavioral intervention is to increase tolerance to delays to reinforcement or times when reinforcers are unavailable. NCR using alternative reinforcers has also been shown to maintain low levels of problem behavior during periods when the functional reinforcer is not available. Simmons et al. (2022) compared the effects of NCR during schedule thinning of the functional reinforcer for four individuals with ASD who exhibited problem behavior including SIB. The researchers signaled time periods when the functional reinforcer was not available and compared levels of problem behavior during control (no items/activities) versus when access to moderately preferred alternative items, moderately preferred attention, and moderately preferred tasks was provided. Results showed more effective and efficient schedule thinning when the participant was provided noncontingent access to alternative activities.

In the case of behavior reinforced by escape from demands, the inclusion of highly preferred reinforcers in an environment may reduce the motivation to escape the situation. Gover et al. (2019) conducted a review of 256 applications of environmental enrichment to automatically reinforced problem behavior (including SIB). Results showed that EE alone reduced SIB to clinically appropriate levels in 44.6% of cases. EE plus an additional consequence manipulation reduced SIB to clinically appropriate levels in 56.1% of cases.

The application of NCR and EE is more effective when the items or activities used within them are identified via systematic assessment such as preference or reinforcer assessments (Vollmer et al., 1994). Preference assessments involve the presentation of various stimuli (e.g., toys, edibles) and direct observation of item selection and engagement, whereas reinforcer assessments test the efficacy of the stimulus at increasing a target response (see Kang et al., 2013 for a review). Conducting these assessments ensures that individuals will engage with the item, that the item functions as a reinforcer, or both. A similar assessment is the Competing Stimulus Assessment (CSA), which is a preassessment to identify items to include in NCR (e.g., Piazza et al., 1998). During CSAs, individuals are presented with stimuli, and data are collected on both item engagement and levels of problem behavior. Stimuli associated with high levels of engagement and low levels of problem behavior are then incorporated into treatment. CSAs have been effective at identifying competing items for a variety of functions of problem behavior (Haddock & Hagopian, 2020). In some cases, procedural modifications, such as prompting and reinforcement, may be necessary to increase engagement with potential competing items (e.g., Hagopian et al., 2020; Leif et al., 2020). Hagopian et al. conducted traditional CSAs and found that they were ineffective at identifying competing items for 6 participants who exhibited SIB. They re-presented the items and implemented prompting for item engagement and response blocking for SIB. The augmented CSA effectively identified items for all 6 participants.

Noncontingent reinforcement, and related, procedures have several important advantages. First, continuous access to functional or alternative reinforcers provides a powerful intervention to greatly reduce SIB. For this reason, continuous NCR may be indicated as a first step when the safety of the individual is in danger. Second, NCR is relatively easy to implement because reinforcers are delivered based on time (rather than observation of behavior). Thus, therapists do not need to constantly attend to the individual in order to implement the procedure correctly. Third, NCR is effective across a range of functions and topographies.

Noncontingent reinforcement is associated with at least three main disadvantages. First, NCR does not specifically promote adaptive behavior. For that reason, NCR should be considered just one component of an effective behavioral intervention including differential reinforcement of alternative behavior. Second, NCR may compete with other schedules of reinforcement. For example, Goh et al. (2000) showed that dense schedules of NCR decreased SIB to low levels but interfered with the participants' acquisition of mands for the functional reinforcer. The schedule of NCR had to be thinned before manding emerged. Although continuous or dense schedules of NCR may be necessary early in treatment to reduce SIB to safe and manageable levels, these schedules should be thinned to avoid interference with development of adaptive skills. Third, on rare occasions, NCR may strengthen problem behavior as a result of accidental pairings between behavior and reinforcer delivery (e.g., Vollmer et al., 1997). This problem can be addressed by including a momentary differential reinforcement of other behavior (mDRO) component, or brief temporal gap before reinforcer delivery, to ensure that the SIB and reinforcer are not coupled on a consistent basis (e.g., Lindberg et al., 1999).

Increasing Appropriate Alternative Skills

The second main component of a comprehensive function-based treatment is increasing appropriate alternative skills. Behavior analysts recognize that SIB occurs as a function of environmental consequences, and simply targeting SIB for reduction without teaching the individual new ways to access reinforcers would be unethical. Appropriate alternative skills are often strengthened via differential reinforcement of alternative behavior (DRA). During DRA, reinforcers are provided at greater levels (i.e., along at least one dimension) for alternative skills and reinforcers are minimized for problem behavior (Vollmer et al., 2020). As a result, problem behavior is reduced by strengthening specific responses to compete with the target response.

One variant of DRA is *functional communication training* (FCT). In FCT the alternative behavior takes the form of a conventional communication response and can be used to obtain the same reinforcer previously maintaining problem behavior (Carr & Durand, 1985; Durand & Carr, 1991). The form of the appropriate behavior may be determined by considering the abilities of the student (in terms of their existing communicative repertoire) and the readiness of the community to respond appropriately to the communicative response. In general, the response effort to engage in the functional communication response should be low, and the schedule of reinforcement should, at least initially, be continuous until the individual is exhibiting the skill regularly and across environments (Tiger et al., 2008).

As a treatment to reduce problem behavior reinforced by social positive reinforcement (in the form of attention or access to tangibles), FCT involves teaching the individual how to request and then providing attention or tangibles following each appropriate request. Likewise, to reduce problem behavior reinforced by social negative reinforcement (in the form of escape from task demands), FCT would consist of providing a momentary reprieve from the work materials. For example, if the individual were to sign "break" during an instructional sequence, the therapist might quickly remove the task materials and turn away from the individual for 30 s. Marcus and Vollmer (1995) investigated the use of DRA to reduce a girl's disruptive behavior reinforced by social negative reinforcement in the form of escape from demands. In one condition, breaks were provided following appropriate requests. In another condition, breaks were provided following compliance with the academic demands. Both conditions produced decreases in disruptions; however, compliance remained low in the condition in which requests were reinforced by a break and compliance increased in the condition in which breaks were provided following compliance. Thus, it is important at times to consider DRA procedures that do not necessarily reinforce communication per se but that target some other specific replacement behavior. Most published treatment evaluations of DRA have used the procedure in conjunction with extinction for problem behavior. That is, appropriate alternative responses were reinforced on dense schedules while reinforcers were withheld for problem behavior. For several reasons, however, extinction for problem behavior may not be advised.

A DRA approach offers certain advantages when extinction is not a viable treatment component. First, DRA may be implemented with alternative reinforcers which compete with the functional reinforcers for self-injury. For example, several studies have shown that positive reinforcement for compliance may decrease escape-maintained problem behavior and increase compliance, even as problem behavior continues to be reinforced with breaks from demands (e.g., Carter, 2010; Slocum & Vollmer, 2015). Second, DRA may be implemented by altering parameters of reinforcement such as quality, amount, delay, and ratio-requirement for both problem and appropriate behavior in a way to favor appropriate behavior (e.g., Athens & Vollmer, 2010; Kunnavatana et al., 2018). Baum (1974) described the matching law, a quantitative description of behavior that can account for variations in reinforcement parameters. The matching law predicts that, in situations in which two responses are available (e.g., problem and appropriate behavior), more behavior will be allocated toward the response associated with higher frequencies, higher quality, higher quantity, and lower delays to reinforcement. When applied to problem behavior, if a care provider must present attention following problem behavior (e.g., SIB that would produce immediate tissue damage), the parent could provide brief, lower quality attention following SIB (e.g., minimal physical guidance or blocking) compared to following appropriate requests (e.g., high levels of verbal praise, high fives, special toys, or treats). For less serious problem behavior, delays and ratio-requirements could also be manipulated. For example, a parent might only provide attention following a brief delay after every other instance of problem behavior as compared to providing attention immediately after every instance of appropriate behavior. Kunnavatana et al. assessed participants' sensitivity to or preference for the different parameters and used the results to implement differential reinforcement in the treatment of problem behavior. Results showed that when both problem behavior and appropriate behavior resulted in the same consequence, participants exhibited high rates of problem behavior. When appropriate behavior resulted in higher magnitude or higher quality reinforcers, problem behavior decreased to zero levels.

In addition to the advantages described above, DRA specifically arranges for the strengthening of appropriate behavior while reducing competing inappropriate behavior. Effects of DRA in the form of FCT may also be more likely than effects of other procedures to persist outside of the treatment environment if the communicative response is likely to produce the maintaining reinforcer in other environments (such as with the use of conventional speech). One disadvantage of DRA, at least in the form of FCT, is that for some individuals, a punishment component is sometimes necessary (e.g., Hagopian et al., 1998; Hanley et al., 2005; Rooker et al., 2013). However, the need for punishment procedures may be mitigated when additional supports such as visual cues are implemented (e.g., Greer et al., 2016).

Another DRA approach is to "treat" SIB by building a wide range of replacement skills via reinforcement procedures including shaping, chaining, and modeling. The notion is that the more extensive the adaptive repertoire, the less time an individual has to engage in SIB. This approach targets specific skills or sets of skills, not as a direct functional replacement for SIB, but rather on the premise that the ability to communicate generally, engage in appropriate leisure activity, and engage in work or academic ability in some way supplants the likelihood of engaging in SIB. The approach is consistent with basic research on the matching law, which suggests that individuals allocate their behavior toward reinforcers that are more frequent and easier to obtain. One form of the matching law, single-alternative matching (de Villiers, 1977), describes the relation between engaging in one response, the reinforcers available for that response, engaging in all other responses, and all other available reinforcers. For individuals who engage in SIB, response allocation may be considered a "choice" between engaging in SIB and engaging in anything else (the term choice is used here in a technical sense and is not intended to imply that the individual wants to engage in SIB). From the perspective of the matching law, a person may be less likely to engage in SIB if reinforcers for other behavior are more readily available. It follows then that SIB (or other forms of severe problem behavior) may be suppressed by teaching individuals new ways of obtaining reinforcement. That is, by increasing the reinforcers available for "doing anything else," the relative payoff for engaging in SIB will be reduced.

When SIB is evoked by the presentation of certain environmental stimuli (e.g., instructional demands, medical/dental procedures, noise), then systematic fading, desensitization of the stimuli, or both, may be useful. Initially, stimuli that evoke SIB are removed from the environment and then gradually introduced as SIB remains low. Reinforcers are provided for the absence of SIB or contingent upon appropriate alternative behavior, such as compliance with instructions. Stuesser and Roscoe (2020) compared the effects of differential reinforcement and differential reinforcement plus stimulus fading in the treatment of problem behavior maintained by escape from medical exams. Results showed that stimulus fading, conducted by breaking down exams into smaller components and introducing them gradually, was necessary to increase compliance and reduce problem behavior. In another example, Ricciardi et al. (2006) evaluated contact desensitization to treat a phobia (i.e., screaming, aggression, elopement) to animatronic objects exhibited by an 8-year-old with ASD. They initially provided noncontingent access to preferred activities 6 m away from the target object. Then they gradually decreased the proximity to the target object to maintain reinforcer access. The treatment package was effective at decreasing problem behavior and increasing approaches to the animatronic object, even in the absence of extinction procedures.

Consequence-Based Strategies

Treatment plans should also specify what to do when the target behavior occurs. Procedurally, extinction involves withholding reinforcers that were previously delivered following behavior (Catania, 1998). Extinction results in a gradual decrease in the likelihood of behavior (Skinner, 1938). In addition to the gradual decrease in behavior (main effect of extinction), the procedure is also commonly associated with potentially adverse side effects sometimes collectively referred to as an extinction burst (Lerman & Iwata, 1996). These side effects may include temporary increases in rate and intensity of the target behavior as well as aggression and an increase in topographical variations of self-injury (including both novel and previously reinforced forms). Additionally, a number of factors may lead to the reemergence of previously extinguished self-injury including changes in environmental context, also known as renewal (e.g., Muething et al., 2020) or extinction of or decreases in reinforcement schedules for alternative behavior, also known as resurgence (e.g., Wacker et al., 2013).

Therefore, extinction should rarely, if ever, be used in isolation. More commonly it is used as a component within a larger treatment package. The specific form of the extinction procedure may appear different depending on the source of reinforcement being withheld (Iwata et al., 1994b). For example, extinction of behavior maintained by social positive reinforcement in the form of attention would likely involve minimizing attention toward the individual following instances of SIB (e.g., Iwata et al., 1994b). Conversely, extinction of SIB maintained by social negative reinforcement in the form of escape from instructional activities would involve continued presentation of the instructional activity following problem behavior (e.g., Iwata et al., 1990). In either case, extinction necessitates that the reinforcers no longer follow behavior.

When reinforcement for SIB is socially mediated, with the exception of situations in which safety prohibits it, it is usually possible for the care-provider to at least minimize reinforcement. However, when SIB is automatically reinforced it is more difficult to withhold reinforcement because the reinforcement is not directly controlled by a care-provider. Nonetheless, the procedure known as "sensory extinction" provides a model for extinction of automatically reinforced behavior (Rincover, 1978). For example, Iwata et al. (1994b) implemented extinction of one individual's head banging by placing a helmet on the individual's head. Rates of SIB decreased markedly when the helmet was worn. Presumably, the helmet served to attenuate the sensation caused by head banging because the individual was still able to engage in the response (and did, initially) while only the products of the response changed. Therefore, the behavior decreased when its reinforcing consequences were no longer available. Similar effects have been reported with gloves (for hand biting) and other protective equipment (e.g., Roscoe et al., 1998).

Because extinction in isolation is rarely recommended, practitioners should include a plan for the individual to access reinforcement in another manner. In addition to NCR and DRA procedures, differential reinforcement of other behavior (DRO) involves the delivery of reinforcers for the absence or non-occurrence of behavior for a set time period. For example, if SIB is maintained by access to tangibles, then tangible items can be delivered every 5 min as long as SIB has not occurred. One potential advantage of DRO is that, when combined with extinction, it may attenuate some of the potential side effects of extinction (Homer & Peterson, 1980). That is, unlike with pure extinction, the individual still has some access to the reinforcer. However, DRO has been associated with aggression (Lennox et al., 1987) and emotional behavior (Cowdery et al., 1990). Differential reinforcement of other behavior has other noteworthy disadvantages. For example, the procedure may result in low rates of reinforcement if rates of the target response remain high. In such cases, DRO is functionally equivalent to extinction and in turn may produce side effects similar to the extinction burst (Vollmer et al., 1993). Additionally, DRO does not explicitly promote appropriate alternative behavior. Although appropriate behavior may indeed occur during intervals in which SIB does not occur, the procedure neither ensures that appropriate behavior occurs or that other inappropriate behavior does not occur during reinforced intervals (e.g., Jessel et al., 2015). When alternative reinforcers are used (as is often the case with behavior maintained by automatic reinforcement), DRO may be less effective because the success of the intervention depends on the ability of these reinforcers to compete with the reinforcers maintaining problem behavior (Carr & Durand, 1985; Cowdery et al., 1990).

In some cases, the severity of SIB (including resistance to treatment) may necessitate additional behavior reduction procedures. Punishment is the suppression of behavior as a result of the presentation or removal of stimuli following behavior (Miltenberger, 2008). While both punishment procedures have been used historically, they should be considered a last resort to intervention. At times it may be considered unreasonable or unethical to continue to implement an ineffective treatment when other procedures (i.e., punishment procedures) could be effective. Perhaps the most severe and intractable cases of dangerous SIB could be immediately suppressed via punishment, while other (more widely accepted) treatments could be incorporated. Of course, careful peer review and proper ethics training would be a prerequisite to usage of punishment procedures, or for that matter any procedures designed to reduce dangerous SIB.

Conclusion

Self-injury is a dangerouss form of behavior that occurs in some individuals diagnosed with ASD. A majority of evidence supports the notion that SIB is, at least in part, learned behavior. Behavioral assessment methods are designed to identify reinforcers maintaining SIB so that more effective treatments can be developed. Although assessment components have advantages and disadvantages, collectively the idea is to link the assessment information directly to treatment development. The most effective treatments involve multiple antecedent and consequent components to reduce motivation to engage in SIB and to promote functional and pivotal alternative behavior. It is important to consider the overall skill repertoire of the individual and to teach replacement behavior even if it is not directly or functionally related to SIB. In addition, although controversial, there may be some severe cases where punishment should be considered in the best interest of the individual. In any case of dangerous SIB, peer review is recommended so that the decision-making process of the practitioner is suitably aided by input from colleagues.

References

Athens, E. S., & Vollmer, T. R. (2010). An investigation of differential reinforcement of alternative behavior without extinction. *Journal of Applied Behavior Analysis, 43*(4), 569–589. https://doi.org/10.1901/jaba.2010.43-569

Baum, W. M. (1974). On two types of deviation from the matching law: Bias and undermatching. *Journal of the Experimental Analysis of Behavior, 22*(1), 231–242. https://doi.org/10.1901/jeab.1974.22-231

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 1–21. https://doi.org/10.1002/jaba.30

Bijou, S. W., Peterson, R. F., & Ault, M. H. (1968). A method to integrate descriptive and experimental field studies at the levels of data and empirical concepts. *Journal of Applied Behavior Analysis, 1*, 175–191. https://doi.org/10.1901/jaba.1968.1-175

Bosch, J., Van Dyke, C., Smith, S. M., & Poulton, S. (1997). Role of medical conditions in the exacerbation of self-injurious behavior: An exploratory study. *Mental Retardation, 35*(2), 124–130. https://doi.org/10.1352/0047-6765(1997)035<0124:ROMCIT>2.0.CO;2

Borrero, C. S. W., & Borrero, J. C. (2008). Descriptive and experimental analyses of potential precursors to problem behavior. *Journal of Applied Behavior Analysis, 41*, 83–96. https://doi.org/10.1901/jaba.2008.41-83

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communications training. *Journal of Applied Behavior Analysis, 18*, 111–126. https://doi.org/10.1901/jaba.1985.18-111

Carr, J. E., Coriaty, S., Wilder, D. A., Gaunt, B. T., Dozier, C. L., Britton, L. N., Avina, C., & Reed, C. L. (2000). A review of "noncontingent" reinforcement as treatment for the aberrant behavior of individuals with developmental disabilities. *Research in Developmental Disabilities, 21*(5), 377–391. https://doi.org/10.1016/S0891-4222(00)00050-0

Carr, E. G., Smith, C. E., Giacin, T. A., Whelan, B. M., & Pancari, J. (2003). Menstrual discomfort as a biological setting event for severe problem behavior: Assessment and intervention. *American Journal on Mental Retardation, 108*(2), 117. https://doi.org/10.1352/0895-8017(2003)108%3C0117:MDAABS%3E2.0.CO;2

Carr, E. G., & Smith, C. E. (1995). Biological setting events for self-injury. *Mental Retardation and Developmental Disabilities Research Reviews, 1*(2), 94–98. https://doi.org/10.1002/mrdd.1410010204

Carter, S. L. (2010). A comparison of various forms of reinforcement with and without extinction as treatment for escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 43*, 543–546. https://doi.org/10.1901/jaba.2010.43-543

Catania, A. C. (1998). *Learning* (4th ed.). Prentice Hall.

Cataldo, M. F., & Harris, J. (1982). The biological basis for self-injury in the mentally retarded. *Analysis and Intervention in Developmental Disabilities, 2*(1), 21–39. https://doi.org/10.1016/0270-4684(82)90004-0

Christensen, T. J., Ringdahl, J. E., Bosch, J. J., Falcomata, T. S., Luke, J. R., Marc, S., & Andelman, M. S. (2008). Constipation associated with self-injurious and aggressive behavior exhibited by a child diagnosed with autism. *Education and Treatment of Children, 32*(1), 89–103. https://doi.org/10.1353/etc.0.0041

Contreras, B. P., Tate, S. A., Morris, S. L., & Kahng, S. (in press). A systematic review of the correspondence between descriptive assessment and functional analysis. *Journal of Applied Behavior Analysis*.

Cowdery, G. E., Iwata, B. A., & Pace, G. M. (1990). Effects and side-effects of DRO as treatment for self-injurious behavior. *Journal of Applied Behavior Analysis, 23*, 497–506. https://doi.org/10.1901/jaba.1990.23-497

de Villiers, P. (1977). Choice in concurrent schedules and a quantitative formulation of the law of effect. In *Handbook of operant behavior* (pp. 233–287). Routledge.

Dominick, K., Davis, N. O., Lainhart, J., Tager-Flusberg, H., & Folstein, S. (2007). Atypical behaviors in children with autism and children with a history of language impairment. *Research in Developmental Disabilities, 28*, 145–162. https://doi.org/10.1016/j.ridd.2006.02.003

Durand, V. M., & Carr, E. G. (1991). Functional communication training to reduce challenging behavior: Maintenance and application in new settings. *Journal of Applied Behavior Analysis, 24*, 251–264. https://doi.org/10.1901/jaba.1991.24-251

Durand, V. M., & Crimmins, D. B. (1988). Identifying the variables maintaining self-injurious behavior. *Journal of Autism and Developmental Disorders, 18*, 99–117. https://doi.org/10.1007/BF02211821

Fisher, W. W., Piazza, C. C., Bowman, L. G., Hanley, G. P., & Adelinis, J. D. (1997). Direct and collateral effects of restraints and restraint fading. *Journal of Applied Behavior Analysis, 30*, 105–120. https://doi.org/10.1901/jaba.1997.30-105

Goh, H., Iwata, B. A., & DeLeon, I. G. (2000). Competition between noncontingent and contingent reinforcement schedules during response acquisition. *Journal of Applied Behavior Analysis, 33*, 195–205. https://doi.org/10.1901/jaba.2000.33-195

Gover, H. C., Fahmie, T. A., & McKeown, C. A. (2019). A review of environmental enrichment as treatment for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 52*(1), 299–314. https://doi.org/10.1002/jaba.508

Greer, B. D., Fisher, W. W., Saini, V., Owen, T. M., & Jones, J. K. (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. *Journal of Applied Behavior Analysis, 49*(1), 1–17. https://doi.org/10.1002/jaba.265

Haddock, J. N., & Hagopian, L. P. (2020). Competing stimulus assessments: A systematic review. *Journal of Applied Behavior Analysis, 53*(4), 1982–2001. https://doi.org/10.1002/jaba.754

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J. T., & LeBlanc, L. A. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis, 31*, 211–235. https://doi.org/10.1901/jaba.1998.31-211

Hagopian, L. P., Frank-Crawford, M. A., Javed, N., Fisher, A. B., Dillon, C. M., Zarcone, J. R., & Rooker, G. W. (2020). Initial outcomes of an augmented competing stimulus assessment. *Journal of Applied Behavior Analysis, 53*(4), 2172–2185. https://doi.org/10.1002/jaba.725

Hagopian, L. P., Rooker, G. W., & Zarcone, J. R. (2015). Delineating subtypes of self-injurious behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 48*(3), 523–543. https://doi.org/10.1002/jaba.236

Hanley, G. P., Piazza, C. C., Fisher, W. W., & Maglieri, K. A. (2005). On the effectiveness of and preference for punishment and extinction components of function-based interventions. *Journal of Applied Behavior Analysis, 38*(1), 51–65. https://doi.org/10.1901/jaba.2005.6-04

Holburn, C. S. (1986). Aerophagia: An uncommon form of self-injury. *American Journal of Mental Deficiency, 91*(2), 201–203. https://doi.org/10.1007/s10803-020-04443-1

Homer, A. L., & Peterson, L. (1980). Differential reinforcement of other behavior: A preferred response elimination procedure. *Behavior Therapy, 11*(4), 449–471. https://doi.org/10.1016/S0005-7894(80)80063-3

Humenik, A. L., Curran, J., Luiselli, J. K., & Child, S. N. (2008). Intervention for self-injury in a child with autism: Effects of choice and continuous access to preferred stimuli. *Behavioral Development Bulletin, 14*(1), 17. https://doi.org/10.1037/h0100503

Hutchinson, R. R. (1977). By-products of aversive control. In W. K. Honig & J. E. R. Staddon (Eds.), *Handbook of operant behavior* (1st ed., pp. 415–431). Routledge. https://doi.org/10.4324/9781003256670

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994a). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. https://doi.org/10.1901/jaba.1994.27-197

Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994b). What makes extinction work: An analysis of procedural form and function. *Journal of Applied Behavior Analysis, 27*(1), 131–144. https://doi.org/10.1901/jaba.1994.27-131

Iwata, B. A., Pace, G. M., Kalsher, M. J., Cowdery, G. E., & Cataldo, M. F. (1990). Experimental analysis and extinction of self-injurious escape behavior. *Journal of Applied Behavior Analysis, 23*(1), 11–27. https://doi.org/10.1901/jaba.1990.23-11

Jessel, J., Borrero, J. C., & Becraft, J. L. (2015). Differential reinforcement of other behavior increases untargeted behavior. *Journal of Applied Behavior Analysis, 48*(2), 402–416. https://doi.org/10.1002/jaba.204

Kahng, S. W., Abt, K. A., & Schonbachler, H. E. (2001). Assessment and treatment of low-rate high-intensity problem behavior. *Journal of Applied Behavior Analysis, 34*(2), 225–228. https://doi.org/10.1901/jaba.2001.34-225

Kahng, S., Leak, J., Vu, C., & Mishler, B. (2008). Mechanical restraints as positive reinforcers for aggression. *Behavioral Interventions, 23*, 137–142. https://doi.org/10.1002/bin.260

Kang, S., O'Reilly, M., Lancioni, G., Falcomata, T. S., Sigafoos, J., & Xu, Z. (2013). Comparison of the predictive validity and consistency among preference assessment procedures: A review of the literature. *Research in Developmental Disabilities, 34*(4), 1125–1133. https://doi.org/10.1016/j.ridd.2012.12.021

Kettering, T. L., Fisher, W. W., Kelley, M. E., & LaRue, R. H. (2018). Sound attenuation and preferred music in the treatment of problem behavior maintained by escape from noise. *Journal of Applied Behavior Analysis, 51*(3), 687–693. https://doi.org/10.1002/jaba.475

Kennedy, C. H., & Meyer, K. A. (1996). Sleep deprivation, allergy symptoms, and negatively reinforced problem behavior. *Journal of Applied Behavior Analysis, 29*(1), 133–135. https://doi.org/10.1901/jaba.1996.29-133

Kunnavatana, S. S., Bloom, S. E., Samaha, A. L., Slocum, T. A., & Clay, C. J. (2018). Manipulating parameters of reinforcement to reduce problem behavior without extinction. *Journal of Applied Behavior Analysis, 51*, 283–302. https://doi.org/10.1002/jaba.443

Lang, R., White, P. J., Machalicek, W., Rispoli, M., Kang, S., Aquilar, J., O'Reilly, M., Sigafoos, J., Lancioni, G., & Didden, R. (2009). Treatment of bruxism in individuals with developmental disabilities: A systematic review. *Research in Developmental Disabilities, 30*(5), 809–818. https://doi.org/10.1016/j.ridd.2008.12.006

Leif, E. S., Roscoe, E. M., Ahearn, W. H., Rogalski, J. P., & Morrison, H. (2020). Increasing item engagement and decreasing automatically reinforced problem behavior within a modified competing stimulus assessment. *Journal of Applied Behavior Analysis, 53*(3), 1638–1659. https://doi.org/10.1002/jaba.695

Lennox, D. B., Miltenberger, R. G., & Donnelly, D. R. (1987). Response interruption and DRL for the reduction of rapid eating. *Journal of Applied Behavior Analysis, 20*(3), 279–284. https://doi.org/10.1901/jaba.1987.20-279

Lerman, D. C., & Iwata, B. A. (1996). Developing a technology for the use of operant extinction in clinical settings: An examination of basic and applied research. *Journal of Applied Behavior Analysis, 29*(3), 345–385. https://doi.org/10.1901/jaba.1996.29-345

Lerman, D. C., Iwata, B. A., Smith, R. G., & Vollmer, T. R. (1994). Restraint fading and the development of alternative behaviour in the treatment of self-restraint and self-injury. *Journal of Intellectual Disability Research, 38*(2), 135–148. https://doi.org/10.1111/j.1365-2788.1994.tb00369.x

Lindberg, J. S., Iwata, B. A., Kahng, S., & DeLeon, I. G. (1999). DRO contingencies: An analysis of variable-momentary schedules. *Journal of Applied Behavior Analysis, 32*(2), 123–136. https://doi.org/10.1901/jaba.1999.32-123

Lloveras, L., Slanzi, C., & Vollmer, T. (2022). New (old) perspectives on self-injurious and aggressive biting. *Journal of Applied Behavior Analysis, 55(3),* 674–687.

Lomas, J. E., Fisher, W. W., & Kelley, M. E. (2010). The effects of variable-time delivery of food items and praise on problem behavior reinforced by escape. *Journal of Applied Behavior Analysis, 43*(3), 425–435. https://doi.org/10.1901/jaba.2010.43-425

Marcus, B. A., & Vollmer, T. R. (1995). Effects of differential negative reinforcement on disruption and compliance. *Journal of Applied Behavior Analysis, 28*(2), 229–230. https://doi.org/10.1901/jaba.1995.28-229

Matson, J. L., & Vollmer, T. R. (1995). *User's guide: Questions about behavioral function (QABF).* Scientific.

Miller, J. R., Lerman, D. C., & Fritz, J. N. (2010). An experimental analysis of negative reinforcement contingencies for adult-delivered reprimands. *Journal of Applied Behavior Analysis, 43*, 769–773. https://doi.org/10.1901/jaba.2010.43-769

Miltenberger, R. G. (2008). *Behavior modification: Principles and procedures* (4th ed.). Thompson Wadsworth.

Muething, C., Call, N., Pavlov, A., Ringdahl, J., Gillespie, S., Clark, S., & Mevers, J. L. (2020). Prevalence of renewal of problem behavior during context changes. *Journal of Applied Behavior Analysis, 53*(3), 1485–1493. https://doi.org/10.1002/jaba.672

O'Neill, R. E., Horner, R. H., Albin, R. W., Sprague, J. R., Storey, K., & Newton, J. S. (1997). *Functional assessment and program development for problem behavior: A practical handbook* (2nd ed.). Brooks. https://doi.org/10.1017/s1030011200024611

O'Reilly, M. F. (1997). Functional analysis of episodic self-injury correlated with recurrent otitis media. *Journal of Applied Behavior Analysis, 30*(1), 165–167. https://doi.org/10.1901/jaba.1997.30-165

Peine, H. A., Darvish, R., Adams, K., Blakelock, H., Jenson, W., & Osborne, J. G. (1995). Medical problems, maladaptive behaviors, and the developmentally disabled. *Behavioral Interventions, 10*(3), 149–159. https://doi.org/10.1002/bin.2360100304

Phillips, C. L., Iannaccone, J. A., Rooker, G. W., & Hagopian, L. P. (2017). Noncontingent reinforcement for the treatment of severe problem behavior: An analysis of 27b consecutive applications. *Journal of Applied Behavior Analysis, 50*(2), 357–376. https://doi.org/10.1002/jaba.376

Piazza, C. C., Adelinis, J. D., Hanley, G. P., Goh, H. L., & Delia, M. D. (2000). An evaluation of the effects of matched stimuli on behaviors maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 33*(1), 13–27. https://doi.org/10.1901/jaba.2000.33-13

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., & Keeney, K. M. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis, 31*(2), 165–189. https://doi.org/10.1901/jaba.1998.31-165

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Ortega, J. V., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46*(1), 47–60. https://doi.org/10.1002/jaba.26

Reed, D. D., Luiselli, J. K., Miller, J. R., & Kaplan, B. A. (2013). Therapeutic restraint and protective holding. In *Handbook of crisis intervention and developmental disabilities* (pp. 107–120). https://doi.org/10.1007/978-1-4614-6531-7_7

Reed, D. D., Luiselli, J. K., Morizio, L. C., & Child, S. N. (2010). Sequential modification and the identification of instructional components occasioning self-injurious behavior. *Child & Family Behavior Therapy, 32*(1), 1–16. https://doi.org/10.1080/07317100903539642

Ricciardi, J. N., Luiselli, J. K., & Camare, M. (2006). Shaping approach responses as intervention for specific phobia in a child with autism. *Journal of Applied Behavior Analysis, 39*(4), 445–448. https://doi.org/10.1901/jaba.2006.158-05

Richman, D. M., & Lindauer, S. E. (2005). Longitudinal assessment of stereotypic, proto-injurious, and self-injurious behavior exhibited by young children with developmental delays. *American Journal on Mental Retardation, 110*(6), 439. https://doi.org/10.1352/0895-8017(2005)110[439:laospa]2.0.co;2

Rincover, A. (1978). Sensory extinction: A procedure for eliminating self-stimulatory behavior in developmentally disabled children. *Journal of Abnormal Child Psychology, 6*(3), 299–310. https://doi.org/10.1007/BF00924733

Rooker, G. W., Iwata, B. A., Harper, J. M., Fahmie, T. A., & Camp, E. M. (2011). False-positive tangible outcomes of functional analyses. *Journal of Applied Behavior Analysis, 44*(4), 737–745. https://doi.org/10.1901/jaba.2011.44-737

Rooker, G. W., Jessel, J., Kurtz, P. F., & Hagopian, L. P. (2013). Functional communication training with and without alternative reinforcement and punishment: An analysis of 58 applications. *Journal of Applied Behavior Analysis, 46*(4), 708–722. https://doi.org/10.1002/jaba.76

Roscoe, E. M., Iwata, B. A., & Zhou, L. (2013). Assessment and treatment of chronic hand mouthing. *Journal of Applied Behavior Analysis, 46*(1), 181–198. https://doi.org/10.1002/jaba.14

Roscoe, E. M., Iwata, B. A., & Goh, H. L. (1998). A comparison of noncontingent reinforcement and sensory extinction as treatments for self-injurious behavior. *Journal of Applied Behavior Analysis, 31*(4), 635–646. https://doi.org/10.1901/jaba.1998.31-635

Roscoe, E. M., Phillips, K. M., Kelly, M. A., Farber, R., & Dube, W. V. (2015). A statewide survey assessing practitioners' use and perceived utility of functional assessment. *Journal of Applied Behavior Analysis, 48*(4), 830–844. https://doi.org/10.1002/jaba.259

Simmons, C. A., Salvatore, G. L., & Zangrillo, A. N. (2022). Efficiency and preference foralternative activities during schedule thinning with functional communication training. *Journal of Applied Behavior Analysis, 55*(1), 101–120. https://doi.org/10.1002/jaba.886

St. Peter, C. C., Vollmer, T. R., Bourret, J. C., Borrero, C. S., Sloman, K. N., & Rapp, J. T. (2005). On the role of attention in naturally occurring matching relations. *Journal of Applied Behavior Analysis, 38*(4), 429–443. https://doi.org/10.1901/jaba.2005.172-04

Schlichenmeyer, K. J., Roscoe, E. M., Rooker, G. W., Wheeler, E. E., & Dube, W. V. (2013). Idiosyncratic variables that affect functional analysis outcomes: A review (2001–2010). *Journal of Applied Behavior Analysis, 46*(1), 339–348. https://doi.org/10.1002/jaba.12

Skinner, B. F. (1938). *The behavior of organisms: An experimental analysis*. Copley Publishing Group.

Skinner, B. F. (1953). *Science and human behavior*. Macmillian.

Slocum, S. K., & Vollmer, T. R. (2015). A comparison of positive and negative reinforcement for compliance to treat problem behavior maintained by escape. *Journal of Applied Behavior Analysis, 48*(3), 563–574. https://doi.org/10.1002/jaba.216

Sloman, K. N., Vollmer, T. R., Cotnoir, N. M., Borrero, C. S., Borrero, J. C., Samaha, A. L., & St Peter, C. C. (2005). Descriptive analyses of caregiver reprimands. *Journal of Applied Behavior Analysis, 38*(3), 373–383. https://doi.org/10.1901/jaba.2005.118-04

Smith, C. E., Carr, E. G., & Moskowitz, L. J. (2016). Fatigue as a biological setting event for severe problem behavior in autism spectrum disorder. *Research in Autism Spectrum Disorders, 23*, 131–144. https://doi.org/10.1016/j.rasd.2015.12.003

Smith, R. G., & Churchill, R. M. (2002). Identification of environmental determinants of behavior disorders through functional analysis of precursor behaviors. *Journal of Applied Behavior Analysis, 35*(2), 125–136. https://doi.org/10.1901/jaba.2002.35-125

Steenfeldt-Kristensen, C., Jones, C. A., & Richards, C. (2020). The prevalence of self-injurious behaviour in autism: A meta-analytic study. *Journal of Autism and Developmental Disorders, 50*(11), 3857–3873.

Stuesser, H. A., & Roscoe, E. M. (2020). An evaluation of differential reinforcement with stimulus fading as an intervention for medical compliance. *Journal of Applied Behavior Analysis, 53*(3), 1606–1621. https://doi.org/10.1002/jaba.685

Thompson, R. H., & Iwata, B. A. (2001). A descriptive analysis of social consequences following problem behavior. *Journal of Applied Behavior Analysis, 34*(2), 169–178. https://doi.org/10.1901/jaba.2001.34-169

Thompson, R. H., & Iwata, B. A. (2005). A review of reinforcement control procedures. *Journal of Applied Behavior Analysis, 38*(2), 257–278. https://doi.org/10.1901/jaba.2005.176-03

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*(1), 16–23. https://doi.org/10.1007/BF03391716

Vaughan, M. E., & Michael, J. L. (1982). Automatic reinforcement: An important but ignored concept. *Behavior, 10*, 217–227.

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities, 15*(3), 187–207. https://doi.org/10.1016/0891-4222(94)90011-6

Vollmer, T. R., Hagopian, L. P., Bailey, J. S., Dorsey, M. F., Hanley, G. P., Lennox, D., Riordan, M. M., & Spreat, S. (2011). The Association for Behavior Analysis International position statement on restraint and seclusion. *The Behavior Analyst, 34*(1), 103–110. https://doi.org/10.1007/BF03392238

Vollmer, T. R., Iwata, B. A., Zarcone, J. R., Smith, R. G., & Mazaleski, J. L. (1993). The role of attention in the treatment of attention-maintained self-injurious behavior: Noncontingent reinforcement and differential reinforcement of other behavior. *Journal of Applied Behavior Analysis, 26*(1), 9–21. https://doi.org/10.1901/jaba.1993.26-9

Vollmer, T. R., Marcus, B. A., & LeBlanc, L. (1994). Treatment of self-injury and hand mouthing following inconclusive functional analyses. *Journal of Applied Behavior Analysis, 27*(2), 331–344. https://doi.org/10.1901/jaba.1994.27-331

Vollmer, T. R., Marcus, B. A., & Ringdahl, J. E. (1995). Noncontingent escape as treatment for self-injurious behavior maintained by negative reinforcement. *Journal of Applied Behavior Analysis, 28*(1), 15–26. https://doi.org/10.1901/jaba.1995.28-15

Vollmer, T. R., Peters, K. P., Kronfli, F. R., Lloveras, L. A., & Ibañez, V. F. (2020). On the definition of differential reinforcement of alternative behavior. *Journal of Applied Behavior Analysis, 53*(3), 1299–1303. https://doi.org/10.1002/jaba.701

Vollmer, T. R., Ringdahl, J. E., Roane, H. S., & Marcus, B. A. (1997). Negative side effects of noncontingent reinforcement. *Journal of Applied Behavior Analysis, 30*(1), 161–164. https://doi.org/10.1901/jaba.1997.30-161

Vollmer, T. R., Sloman, K. N., & Samaha, A. L. (2009). Self–injury. In J. Matson (Ed.), *Applied behavior analysis for children with autism spectrum disorders*. Springer. https://doi.org/10.1007/978-1-4419-0088-3_9

Wacker, D. P., Harding, J. W., Morgan, T. A., Berg, W. K., Schieltz, K. M., Lee, J. F., & Padilla, Y. C. (2013). An evaluation of resurgence during functional communication training. *The Psychological Record, 63*(1), 3–20. https://doi.org/10.11133/j.tpr.2013.63.1.001

15 Aggression and Tantrums and Applied Behavior Analysis (ABA)

Joshua Jessel and Valdeep Saini

Brief synopsis: *These are common problems that can markedly impair development of children with autism. Forms of aggression and tantrum presented by this population will be discussed along with methods of assessment and treatment.*

Contents

Autism spectrum disorder (ASD) is characterized by a number of co-occurring cognitive and behavioral deficits or excesses. Some of the criteria used to diagnose ASD include impairments in communication and social skills, as well as restrictive and repetitive behaviors that persist across environments (American Psychiatric Association, 2013). In general, these traits can have a significant impact on an individual's adaptive functioning and could interfere with daily living skills (Szatmari et al., 2015). Further impacting the long-term adaptive trajectory of individuals with ASD is comorbid psychopathology and occurrence of challenging behaviors such as self-injury, environmental destruction, tantrums, and aggression (Antonacci et al., 2008; Rojahn et al., 2007). Individuals with ASD who engage in severe challenging behavior such as aggression and tantrums are at increased risk for denial of services, expulsion from school, social isolation, institutionalization, overuse of medication, physical restraint, and physical abuse (Antonacci et al., 2008; Lunsky et al., 2017; McGillivray & McCabe, 2004). As a result, clini-

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cians working in the field of Applied Behavior Analysis (ABA) have focused their efforts on reducing challenging behavior, including aggression and tantrums, in individuals with ASD (Brosnan & Healy, 2011; Matson & Jang, 2014; Ringdahl et al., 2009).

Aggression is generally defined as behavior that is threatening to others or likely to cause harm to others, including attempts at causing harm to others. Broadly, the topography of aggression can be verbal (e.g., swearing or screaming at another person), physical (e.g., kicking, punching, biting, or scratching another person), or make use of physical items in order to aggress (e.g., throwing objects at another person). A person can demonstrate one type of aggressive behavior or many different topographies of aggression can co-occur in what is commonly described as a "tantrum," "outburst," or "meltdown." Tantrums can occur with variable frequency (e.g., daily, weekly), intensity (e.g., mild or moderate), and duration (e.g., 5 minutes or 5 hours). Because of the variability of aggressive behavior observed during tantrums, researchers have defined aggression in different ways. For instance, the Aberrant Behavior Checklist Irritability subscale (Aman & Singh, 1986), the aggression subscale of the Child Behavior Checklist (Farmer et al., 2015), and observational studies in the assessment and treatment of tantrums all classify aggressive behavior somewhat differently (Brosnan & Healy, 2011; Matson & Jang, 2014). Differences in the definition of aggression or tantrums can create challenges in comparing aggression and treatments across individuals. Nonetheless, a rich and robust literature base exists on the characteristics of aggression in individuals with ASD as well as the treatment of challenging behavior in this population based on principles derived from ABA (Brosnan & Healy, 2011).

Some level of tantrums, including aggression and emotional outbursts, appears to be universal and is likely a typical part of child development (Solter, 1992; Potegal & Davidson, 2003). However, rates of aggressive behavior may be higher in individuals with ASD compared to typically developing peers and those with other developmental disabilities (Farmer & Aman, 2011; Fitzpatrick et al., 2016). Some research suggests that aggression occurs in approximately half of individuals diagnosed with ASD, which is significantly higher than the general population (Kanne & Mazurek, 2011; Mazurek et al., 2013). However, estimates on the prevalence of aggression across the lifespan have varied across studies (Hartley et al., 2008; Lecavalier et al., 2006). Importantly, the prevalence of aggressive behavior increases with severity of communication deficits and co-occurring developmental disabilities (Holden & Gitlesen, 2006).

Whereas age, gender, and family dynamics tend to predict rates of aggression and tantrums in neurotypical children in the general population (Tremblay et al., 2004), risk factors for the development and persistence of these challenging behaviors in children with ASD are distinct from typically developing children. For instance, unlike neurotypical children, gender differences do not tend to be associated with higher or lower rates of aggression in children with ASD (Hartley et al., 2008). Similarly, although lower levels of parental education and marital status of parents tend to predict aggression in typically developing children, these variables do not appear to reliably predict aggression in individuals with ASD (Kanne & Mazurek, 2011). Instead, risk factors associated with aggression and tantrums in children with ASD include degree of communication deficits; comorbid developmental, intellectual, or mental health conditions (e.g., anxiety); and general adaptive functioning and autonomy (Hartley et al., 2008; Kanne & Mazurek, 2011). Furthermore, there is also a positive correlation between rates of ritualistic and repetitive behaviors and rates of aggression in children with ASD (Murphy et al., 2009; Reese et al., 2005). Taken together, the extant literature indicates that risk factors for aggression and tantrums are related to the core features of ASD (Matson & Adams, 2014).

Aggression and associated behavioral challenges have a significant impact on the developmental trajectory of children with ASD. As previously described, aggressive behavior is associated with a number of deleterious outcomes including increased exposure to restrictive environments and physical restraints as a means to manage aggression and tantrums (Dagnan & Weston, 2006; Sourander et al., 2002). However, aggressive behavior also has a significant impact on the community and social environment. For example, children with ASD who engage in aggression and tantrums often have poor interpersonal and social skills (Mazurek et al., 2013). Furthermore, aggression and tantrums in schools have been associated with teacher burnout, which could impact the quality of education students with ASD receive (Otero-López et al., 2009). Aggression in children can also serve as a major trigger of parental and family stress and could considerably impact family well-being and happiness (Hodgetts et al., 2013; Tint & Weiss, 2016). Moreover, there is a significant financial burden associated with treating behavioral symptoms of ASD, and these costs may be greater in the presence of challenging behaviors (Fletcher et al., 2012).

Given the negative impact aggression and tantrums have on children with ASD, their families, and the community, a considerable effort has been made to better understand the etiology of these challenging behaviors from an environmental standpoint. Clinicians in the field of ABA have primarily leveraged operant behavior principles to better understand the reasons for aggression that are unique to the child, and then to use that information to form the basis for a behavioral treatment. Understanding the environmental variable(s) that maintain aggression and tantrums has shown to ultimately lead to more effective treatment (Matson & Jang, 2014).

Operant Interpretations of Aggression and Tantrums

A thorough epidemiological understanding of the contributors to aggression and tantrums is likely to include biobehavioral interpretations. For example, there is some evidence to suggest that there may be biomarkers for aggression, implicating some genetic influence (Nicotera et al., 2019; Ray et al., 2011). In fact, the effectiveness of some medication for reducing aggression and tantrums is predicated on the assumption that there is an imbalance of neurotransmitters resulting in a more aggravated state (Frye & Rossignol, 2016; Lam et al., 2006). In addition, there is reason to believe that physiological differences in those diagnosed with ASD, such as epileptiform abnormalities, are correlated with increases in aggressive behaviors (Mulligan & Trauner, 2014). However, any research on the relation between aggressive behavior and specific biological or physiological contributors is still in its infancy. Prevailing theories regarding mechanisms explaining why individuals exhibit aggressive behavior and tantrums are typically focused on principles of learning. That is likely because environmental variables are easy to manipulate, and experimental control over behavior can be demonstrated in a relatively brief amount of time. Furthermore, learning theory offers a highly pragmatic approach that is intimately related to supporting behavioral treatments. Understanding the environmental variables that are contributing to aggression and tantrums often affords the clinician a level of control in altering those variables to support other appropriate behavior.

Operant interpretations of aggression and tantrums specifically refer to the identification of antecedent variables that evoke the behavior and consequences that strengthen, or reinforce the behavior. The combination of these environmental variables and their relation to behavior defines the three-term contingency. For example, a child may hit a sibling because the sibling took their toy (antecedent) and hitting has resulted in the return of their toy in the past (consequence). Alternatively, a child may fall to the ground crying because their mother denied them access to their favorite snacks (antecedent), and the mother has often given in when in public (consequence). These operant mechanisms are ubiquitous and are highly informative for clinicians when interpreting behavior through the lens of the three-term contingency.

While aggression and tantrums can be sensitive to any idiosyncratic, operant contingencies, they are often categorized into four general classes of potential functions (Carr, 1994). The general classes are intended to represent contact with the common challenging situations that children are likely to experience, which can result in the contingent access to positive or negative reinforcement (Ala'i-Rosales et al., 2019). The left side of Table 15.1 summarizes the four general classes of reinforcement as presented in isolated contingencies, that is, the four general classes are represented separately had the child contacted each general class of reinforcement alone without any influence from the other variables at one time.

First, aggression and tantrums are often sensitive to positive reinforcement in the form of attention. For example, a child may exhibit challenging behavior when a parent is preoccupied with a task in order to get the parent to discontinue the task and avert their attention to them. Of course, the type of attention (e.g., reprimands, praise, specific conversations) can vary and impact challenging behavior differently (Kodak et al., 2007). Nevertheless, the general categorization of attention is viewed as a common contributor to challenging behavior. A second form of positive reinforcement that constitutes a general function of aggression and tantrums includes the presentation of preferred items or activities. Losing or denied access to highly preferred items arranges a powerful establishing operation that often requires skill-building training to teach children with ASD how to appropriately access those items without engaging in challenging behavior. In fact, challenging behavior has been found to be easily susceptible to novel contingencies with preferred items even when access to those items following challenging behavior was an unlikely occurrence in the past (Rooker et al., 2011; Shirley et al., 1999).

The third general function focuses on the influence of negative reinforcement in the form of escape from tasks such as academic work. Interestingly, escape has often been found to be the most likely contributor to challenging behavior when assessed in isolation in multiple large-scale reviews and epidemiological studies (Beavers et al., 2013; Hanley et al., 2003; Iwata et al., 1994), thus solidifying the common need for treatment of aggression and tantrums in academic settings. The fourth and final category, while representative of an operant contingency, is somewhat less informative of the type (positive or negative) of reinforcement, that is, because it is often used as an explanation when no socially mediated functions of behavior have been identified and the challenging behavior continues to occur in the absence of others, which has been termed "automatic reinforcement." Although there have been recent attempts to establish subcategories of automatic reinforcement to more definitively establish the roles of positive and negative reinforcement, research has often focused on self-injurious behavior (Hagopian et al., 2015, 2017), where identification of an

Table 15.1 General classes of isolated and synthesized reinforcement

General classes	Reinforcement	Example
Isolated		
Attention	Positive	Access to preferred conversations
Tangible	Positive	Access to favorite toys
Escape	Negative	Escape from academic instructions
Automatic	Positive/negative	Problem behavior produces own source of reinforcement
Synthesized		
Attention/tangible	Positive/positive	Access to interactive play
Attention/escape	Positive/negative	Escape from academic instructions to access preferred conversations
Tangible/escape	Positive/negative	Escape from academic instructions to access favorite toys
Attention/tangible/escape	Positive/positive/negative	Escape from academic instructions to access interactive play

automatic function is far more likely. Such is the circumstances of aggression, whereby it is necessary to have others around to aggress toward, resulting in some form of socially mediated reinforcement. Of course, automatic reinforcement cannot entirely be ruled out in the case of aggression, and there have been multiple documented accounts in the past (e.g., Saini et al., 2015; Thompson et al., 1998).

Although organization of reinforcement into these four general categories may be convenient, it seems far more likely that a child will experience some combination of these contingencies in the home or school environment (Slaton & Hanley, 2018). The combination of multiple influences over challenging behavior has been referred to as a synthesized contingency and can involve multiple disparate variations (see right side of Table 15.1). For example, a child may exhibit aggression or tantrums to regain access to interactive play with others during multiplayer activities, representing a synthesis of positive reinforcement (attention/tangible). Positive and negative reinforcement could also be synthesized and is typically reflective of a transition away from aversive, behavioral expectations to access preferred events. Building off of the previous example, the child may not only be attempting to regain access to interactive play by engaging in aggression or tantrums but escape from an academic table to regain access to the leisure area in which they can play with others.

It is important to point out that these general classes of reinforcement, whether isolated or synthesized, are not intended to be an exhaustive list of potential contributors to aggression and tantrums. It is not always the case that challenging behavior will be so easily compartmentalized into four functions (attention, tangible, escape, automatic) and, in fact, idiosyncratic variables have been found to influence challenging behavior on multiple occasions (Schlichenmeyer et al., 2013). The intricacies of reinforcement are likely to be child and situation specific. Therefore, in order to provide effective, behavioral treatment of aggression and tantrums, it is important for the clinician to establish some level of understanding of what those contingencies are.

Informing Behavioral Treatment of Aggression and Tantrums

The process of developing an understanding of potential environmental influences for challenging behavior has been defined as a functional assessment. The assumption a clinician makes when considering implementing a behavioral treatment for aggression or tantrums is that the target behavior is sensitive to some form of reinforcement, otherwise that behavior would not be occurring. Thus, a clinician conducts a functional assessment to more precisely identify the sources of reinforcement to better inform subsequent, function-based treatment strategies. That is, the functional assessment provides the clinician with the opportunity to take what is hypothesized to be the environmental variables contributing to aggression and tantrums and rearrange the contingency to support more socially acceptable, alternative behavior.

This intimate relation between functional assessment and behavioral treatment is often referred to as treatment utility (Hayes et al., 1987; Kratochwill & Shapiro, 2000), in which a functional assessment is valued by the treatment it is able to inform. While an understanding of the contingencies that influences challenging behavior may help to quell suspicions, it is not until the clinician uses that information to reduce challenging behavior do we really see the significance of conducting a functional assessment. In fact, the function-based approach to treating aggression and tantrums is preferred not only because it can improve treatment efficacy (Campbell, 2003; Herzinger & Campbell, 2007; Heyvaert et al., 2014), but because it eliminates the notion that a child's behavior needs to be modified by any means necessary (i.e., powerful arbitrary reinforcers and punishers) and instead instills a sense of behavioral improvement via an empathetic understanding of the circumstances that have led to the child's current repertoire (Hanley, 2012). The former conceptualization ignores historical influences of operant contingencies, while the latter uses that history to teach more appropriate forms of obtaining those same reinforcers.

A clinician can conduct a functional assessment of aggression and tantrums using three general models (Hagopian et al., 2013). First, the clinician can obtain anecdotal reports from secondary sources such as parents, teachers, or therapists using an indirect assessment. Those directly experiencing the challenging behavior for themselves can provide the clinician with information, from their perspective, regarding antecedents that evoke the behavior, topographies of behavior likely to be observed, and consequences that strengthen behavior. Multiple structured formats exist to help aid clinicians in formulating hypotheses regarding the environmental influences over challenging behavior when conducting an indirect assessment and tend to vary based on how restricted the responders are in providing answers (Sturmey, 1994). That is, some structured formats only allow for yes or no answers, while others create a Likert scale for a range of confidence. Furthermore, open-ended indirect assessments act as a tool for guiding conversations but allow the responder to speak freely about their experiences (Fryling & Baires, 2016).

The second functional assessment model is the descriptive assessment and incorporates a more direct approach to understanding the environmental contributors to challenging behavior. Rather than inferring operant control through indirect reports from others, the descriptive assessment involves the clinician observing the challenging behavior and contingencies for themselves. The observation can range from a hands-off period of time where the clinician collects data on the various antecedents and consequences that are found to naturally co-occur with challenging behavior to a more structured period with the context pre-arranged (Anderson & Long, 2002). It is important to point out that the direct observation of environmental events and challenging behavior allows the clinician to draw more quantitatively informed interpretations of contingencies. For example, the clinician can identify correlations in the time of day in which aggression is likely to occur or calculate the probability of tantrums being exhibited regularly with certain events (Vollmer et al., 2001).

The functional analysis is the third, and most conservative functional assessment model because it relies on a display of control over aggression and tantrums through the systematic manipulation of environmental events (Hanley et al., 2003). The clinician is no longer a passive observer of potential contingencies but arranges for them to occur with challenging behavior. This raises the bar from correlations to an empirical demonstration of control. As a process, the functional analysis requires at least one test condition in which the putative reinforcer is presented contingent on targeted challenging behavior and one control condition in which the reinforcers are presented noncontingently. A functional relation between the reinforcer and aggression is effectively identified when elevated rates of aggression are observed during the test condition and eliminated during the control.

Although functional analysis simply refers to the general process, multiple formats have been developed over the years and often vary based on five core procedural components (Jessel et al., 2020), which are summarized in Table 15.2. These core components are binary in the sense that either a functional analysis incorporates the component into the specific format or it does not. For example, a clinician may conduct a functional analysis assessing isolated contingencies with attention presented contingent on aggression in one test condition and academic materials removed contingent on aggression in a separate test condition. This is juxtaposed with a functional analysis in which the contingencies are synthesized into a single test condition with the academic materials removed and attention presented simultaneously. The decision to incorporate a core procedural component or not is dependent on the clinicians' expressed goals. In the above example, the clinician may decide to decouple attention and escape because they are interested in understanding the influence of each separately; however, they may also choose to synthesize the reinforcement to understand the contingency as it naturally occurs in the classroom context (e.g., the teacher removes the academic work and verbally disciplines the child).

Table 15.2 Core procedural components of the functional analysis

Core procedural component	Definition	Example
1. Multiple test conditions	Including a test condition for each contingency the clinician is interested in assessing	A clinician may conduct a functional analysis with (1) an attention condition to assess problem behavior's sensitivity to accessing attention and (2) an escape condition to assess problem behavior's sensitivity to escaping academic instruction
2. Uniform test conditions	Assessing general classes of reinforcement that do not differ from one participant to the next	If the clinician is interested in understanding the influence of attention, they will include the same statements of concern ("don't do that please, you are hurting me!") for each functional analysis they conduct
3. Play control condition	The context in the control condition is arranged to represent general play with preferred leisure items and noncontingent attention	During the control condition, the clinician provides access to the child's favorite trucks with general compliments made every 30 seconds regardless of problem behavior
4. Isolated contingencies	Reinforcement contingencies are decoupled and assessed separately from one another	If the clinician is interested in understanding the influence of attention and tangibles, they will include two test conditions in the functional analysis instead of combining them both into a single test condition
5. Closed contingency class	Only the severe problem behavior of direct concern is targeted	A child may begin to whine before they tantrum, but the clinician will wait until the child flops to the floor crying before providing the reinforcers in the test condition

Function-Based Treatment of Aggression and Tantrums

Function-based treatments of aggression and tantrums use the information obtained regarding the influence of environmental events to design specific treatment procedures. These treatment procedures are, therefore, reflective of the functional relations that have historically contributed to the target challenging behavior. Function-based treatments are distinguished from arbitrary treatment procedures that do not rely on the results of a functional assessment. For example, clinicians using arbitrary treatment procedures may attempt to provide highly preferred edible or tangible items contingent on some appropriate alternative to aggression or tantrums and combine it with a common form of punishment such as time-out, overcorrection, or reprimands.

The use of arbitrary treatment procedures without conducting a functional assessment can be problematic for two reasons. First, without identifying and discontinuing reinforcement for challenging behavior, the arbitrary reinforcers used to support appropriate alternatives must be more powerful and compete with the functional reinforcers, which will lead to an inefficient and potentially cumbersome treatment package. Second, besides the necessity to more often require the use of punishment during arbitrary treatment procedures, the consequences may not work as intended to reduce aggression and tantrums if they are contraindicative to the functional reinforcers (Iwata et al., 1994). For instance, reprimands may actually worsen challenging behavior if a functional analysis determined that challenging behavior was maintained by access to attention.

General Treatment Strategies

Multiple general strategies for conducting function-based treatments currently exist and depend on how the contingency, historically supporting aggression and tantrums, is manipulated (See Table 15.3). One strategy is to simply eliminate the reinforcers and discontinue the contingency. This is referred to as extinction and could involve ignoring the child if aggression and tan-

Table 15.3 Function-based treatment: general strategies

Strategy	Procedure	Targeted effects	Potential side effects
Extinction	Discontinuation of reinforcement contingency	Decrease problem behavior	Burst of problem behavior, extinction-induced aggression, and emotional responding
Noncontingent reinforcement (NCR)	Reinforcers presented on a time-based schedule	Decrease problem behavior	Burst of problem behavior, incidental reinforcement
Differential reinforcement of other behavior (DRO)	Reinforcers presented following the absence of problem behavior	Decrease problem behavior	Incidental reinforcement of other nontargeted problem behavior
Differential reinforcement of alternative behavior (DRA)	Reinforcers presented contingent on target appropriate behavior	Decrease problem behavior and increase appropriate behavior	No known side effects
Functional communication training (FCT)	Reinforcers presented contingent on target appropriate communication	Decrease problem behavior and increase appropriate communication	No known side effects

trums are sensitive to attention or continuously presenting academic instructions if aggression and tantrums are sensitive to escape. It is important to point out that extinction is never recommended to be conducted in isolation, that is, because extinction is associated with a number of negative side effects including bursts of emotional responding and extinction-induced aggression (Lattal et al., 2013). Furthermore, extinction alone does not use the functional reinforcers to teach the child additional skills.

A similar general strategy termed "noncontingent reinforcement" (NCR) also discontinues the contingent relation between the functional reinforcers and challenging behavior; however, it differs from extinction in that the reinforcers remain in the context in which challenging behavior occurs and are presented on a time-based schedule. NCR is likely to act as an abolishing operation during dense schedules of reinforcement, reducing motivation to exhibit aggression or tantrums because the reinforcers are freely available (Kahng et al., 2000). While NCR has the added benefit of enriching the environment with the inclusion of the functional reinforcers, there are multiple reported side effects as well (Vollmer et al., 1997), in addition to the fact that alternative skills are not targeted for improvement.

Differential reinforcement of other behavior (DRO) takes the functional reinforcers and establishes a contingency with aggression and tantrums opposite to that which historically supported the challenging behavior. In other words, the reinforcers are not presented contingent on challenging behavior but instead on the absence of challenging behavior. Advances to DRO procedures continue to be made such as focusing on the potential for incidentally reinforcing appropriate behavior (Jessel & Ingvarsson, 2016). However, in lieu of a systematically programmed contingency for appropriate behavior, there is uncertainty regarding what other behavior is likely to be incidentally reinforced, and this can include challenging behavior within the same functional class (Jessel et al., 2015).

Differential reinforcement of alternative behavior (DRA) is a general strategy that explicitly arranges for the functional reinforcers to support an appropriate alternative response. Therefore, DRA is unique from the previously described strategies in that it has the added benefit of not only reducing aggression and tantrums but increasing replacement skills. These skills can vary between following adult instructions or completing incompatible tasks and are likely to depend on the child's needs. In addition, communication skills are often targeted, considering that those diagnosed with ASD commonly exhibit language deficits. In fact, specifically targeted communication responses as alternatives to challenging behavior has become so influential that it has been distinguished as a variation of DRA termed "functional communication training" (FCT; Carr & Durand, 1985) and has, independent from other DRA procedures, been validated as a well-established treatment for challenging behavior (Kurtz et al., 2011).

Treatment Extensions

The general treatment strategies often begin with a dense schedule of reinforcement, which is intended to ensure the initial success in reducing challenging behavior. That is, if immediate, rich reinforcement is unable to result in clinically significant gains, this may be evidence for the need of more intensive procedures and other interventions. The general treatment strategies are, by no means, meant to be representative of a treatment's terminal goals. This is especially considering that the focus of many of the general treatment strategies is on reducing behavior (i.e., NCR, DRO, EXT) and not building additional skills such as tolerance for situations when reinforcement is no longer immediately forthcoming. In addition, initial treatment goals may not be representative of what can be accomplished or effective in the child's home or school environment.

For example, a clinician may conduct a functional assessment and find the aggression exhibited by a child in the classroom to be sensitive to escape from completing math work. Implementing NCR would involve periodically allowing the child to escape from work regardless of if they are engaging in aggressive behavior. Reducing the workload on a time-based schedule may correspondingly result in a reduction in aggressive behavior; however, the child may now not be meeting her academic milestones with the reduced time spent completing work. Furthermore, the child may be having difficulty in completing the tasks or communicating for help, and these appropriate repertoires are unlikely to develop on their own. Extensions to the general treatments strategies provide a means for making the procedures more practical and the outcomes more generalizable to the setting and community of interest.

Complexity Training For treatments that involve targeting alternative behavior (e.g., DRA, FCT), one extension can include teaching more complex repertoires (e.g., Ghaemmaghami et al., 2018; Jessel et al., 2018). It is typically recommended that treatments begin by targeting a simple and efficient alternative response to aggression (Tiger et al., 2008). Doing so would reduce the effort of the alternative response in comparison to aggression and increase the likelihood of the treatment being effective. However, the behavioral expectations of the child would now be below their baseline abilities. More complex behavioral repertoires are therefore shaped during treatment extension to improve social acceptability and the developmental appropriateness of the target alternative behavior.

Ghaemmaghami et al. (2018) described a process specific to FCT that involved reinforcing more complex approximations to the eventual target form of communication and extinguishing previously mastered responses. The participants' challenging behavior was determined to be socially mediated and generally related to getting their way. The treatment began with a simple functional communication response (e.g., "my way please") that was well within the participants verbal abilities. After the FCT treatment effectively reduced challenging behavior, the therapist discontinued reinforcement for the simple communication response and began extending the sentence structure (e.g., "may I have my way please"). This process of shaping up increasingly complex communication skills continued until the participants were interacting with the therapist using full sentence structures. While successfully demonstrated with communication, complexity training can be applied to any situation in which the behavioral expectations are lowered during the initial treatments stages with the eventual goal of enhancing the child's repertoires when challenging behavior has been sufficiently addressed.

Reinforcement Thinning Teaching more complex skills may improve the social acceptability and developmental appropriateness of target alternative behavior; however, this does not address the practicality of the treatment procedures. The child may begin to display greater language abilities but continue to ask for the reinforcers at a rate that is unsustainable for a caregiver. For example, a functional assessment may determine that a child's tantrums are sensitive to access to favorite treats. FCT may begin by teaching the child to say, "candy please" and successfully reduce the tantrums. The treatment extension of complexity training may, in multiple steps, teach the child to eventually request, "May I have some candy please?" At this point, the treatment still involves reinforcing every instances of the target-appropriate response and so the caregiver would have to honor every request, which is unlikely to be feasible or even ideal. Reinforcement thinning is the process whereby this initially dense schedule of reinforcement (i.e., continuous reinforcement) is slowly reduced to a rate at which is manageable and better conforms to the context specific expectations. There are various strategies for thinning reinforcement (Hagopian et al., 2011).

One common strategy for thinning reinforcement involves alternating between two distinct schedule components with salient signals (Hanley et al., 2001). Defined as multiple schedules, reinforcement continues to be available in the presence of, for example, a picture of a green circle. This is juxtaposed with a period of time in which reinforcement is no longer available, signaled by a red circle. Initial stages of the multiple schedules begin with the majority of time spent with the green circle present, while the red circle is progressively introduced for greater amounts of time. The eventual goal being for a discrimination to be made between when reinforcement is available and when it is not. For example, a caregiver may be unable to play with their child while cooking dinner. Therefore, the expectation is for the child to accept that the caregiver is unavailable and both appropriate requests and challenging behavior would not produce reinforcement during that time.

The approach to reinforcement thinning using multiple schedules is most appropriate when alternative repertoires already exist to take the place of challenging behavior when reinforcement is not available (e.g., the child can find and engage with other activities). In addition, multiple schedules are specific to situations where the intended goal is time based (e.g., waiting for the bus, waiting for recess to start). However, skills for tolerating delays may need to be taught and returned access to reinforcement may be dependent on behavior and not time. For such occasions, chained schedules may be a more appropriate approach to schedule thinning (Lalli et al., 1995). The process of chained schedules begins with some easy criteria for returning reinforcement, and the criteria is gradually increased in difficulty. Chained schedules are most often applied to situations in which cooperation with instructions is the intended repertoire to replace challenging behavior. That way, thinning reinforcement would involve beginning with returning reinforcement following one instruction to eventually returning reinforcement after cooperating with multiple instructions, with the number of target instructions being determined by the context (e.g., how many instructions needed to complete chores, how many questions on a homework assignment).

Comprehensive Function-Based Treatment Package

Clinicians who implement ABA assessment and treatment procedures are often trained in a scientist-practitioner model, in which they will receive education in single-subject research methodology and applied practice (Dorsey & Harper, 2018). Being trained as a scientist-practitioner places the clinician in a unique position to treat each child differently based on the defining principles of ABA and how they relate to the child's specific situation. In other words, not every child will be prescribed the same treatment for their aggressive behavior and variability is to be anticipated across clinicians. Not only does this model potentially establish an overly broad scope that makes identifying consistent treatment plans difficult, but clinicians may find consuming the research literature and choosing individual treatment components a complex labyrinth of case examples. The literature intended to inform clinicians may often provide evidence of what *has* worked for a small sample of individuals but not what *will* work for cases the clinician is experiencing. This may be particularly worrying in the case of the assessment and treatment of challenging behavior because any wrong decision could result in the return of dangerous topographies such as aggression and tantrums.

To remedy this limitation, Hanley et al. (2014) designed and evaluated a comprehensive function-based treatment package that combines elements of general treatment strategies and extensions to treat challenging behavior from start to finish. That way the clinician need not return to the literature and question every step of the process. The entire treatment package is completed in three phases beginning with the functional assessment.

Phase 1 has been identified as the practical functional assessment (Jessel, 2022). The practical functional assessment begins with an open-ended interview (See appendix of Hanley, 2012) including questions for caregivers regarding the antecedents likely to evoke challenging behavior, the target topographies of challenging behavior and less-dangerous precursors, and the consequences likely to strengthen challenging behavior. The clinician uses the information obtained from the open-ended interview to design an individualized contingency representative of the context in which the challenging behavior has been historically observed to occur. The contingency is arranged in the test condition of the subsequent functional analysis and compared to a control condition of noncontingent reinforcement. The functional analysis is used to validate the information obtained from the open-ended interview and ensures that the clinician is treating the problem as identified by the caregiver. A successful demonstration of control over challenging behavior during the functional analysis initiates Phase 2 of the comprehensive function-based treatment package.

Phase 2 begins with FCT, using the functional reinforcer to strengthen a target-appropriate response and extinguish the challenging behavior. The specific functional communication response is intended to be an omnibus mand that produces all functional reinforcers with a single response (Ward et al., 2021). Using an omnibus mand maintains a proper ratio of low-effort and high reward and increases the probability of the treatment's initial success. The complexity of the omnibus mand is then shaped during complexity training until a more socially acceptable and developmentally appropriate form of communication is reached and challenging behavior remains low.

Finally, in Phase 3 the clinician introduces denials for appropriate communication (e.g., "Sorry, that is not available") and teaches the child how to tolerate these denials by training additional communication responses (e.g., "Ok, that is no problem"). Furthermore, these denials are often followed by some behavioral expectation before reinforcement is re-presented and is gradually increased until a specific level of cooperation with difficult instructions is met. The end goal is for the child to, within the context in which challenging behavior had originally occurred, now (a) use complex communication skills, (b) tolerate when reinforcement has been denied, and (c) cooperate with difficult instructions. The comprehensive function-based treatment package is predicated on the notion that skill building is the best strategy for reducing aggression and the package has been demonstrated in its entirety to be effective in the home (Rose & Beaulieu, 2019), school (Taylor et al., 2018), and clinic (Fiani & Jessel, 2022).

Other Treatment Considerations

Using function-based treatment procedures may increase the probability of implementing an effective treatment that reduces aggression and tantrums; however, there are no certainties in achieving socially significant reductions. For one, a quantitative reduction in challenging behavior does not ensure that a caregiver will correspondingly agree that the obtained effects were helpful and acceptable given their circumstances. For example, the aggressive behavior may be so severe that even a few instances could result in bodily harm to others and require immediate medical attention. Therefore, near elimination of aggression would likely be needed in order to consider the treatment truly effective. How we define the effectiveness of a treatment is not entirely dependent on an objective measure of challenging behavior and must be interpreted on some level of socially meaningful change (Wolf, 1978). Furthermore, a function-based treatment may be deemed to be efficacious under strict limitations, but sustained reductions may not necessarily be maintained once the child is introduced to more natural contexts in which reinforcement is thinned with caregiver implementers in the home or school environment (Ghaemmaghami et al., 2021). In those cases where the function-based treatment does not result in socially meaningful and sustainable change, the treatment can be supplemented with other procedures (Rooker et al., 2013).

Supplemental procedures involve combining multiple strategies, whether they be reinforcement-based or, after all other strategies have been exhausted, reinforcement and punishment-based. Reinforcement-based strategies are overlaid on existing treatment procedures by presenting reinforcers noncontingently throughout the context or contingent on other appropriate behavior that was not originally targeted. As an example, FCT can be supplemented with NCR in that the child will receive access to their favorite toys each time they ask appropriately and every 2 min regardless of behavior. In addition, supplemental reinforcement strategies need not rely on the functional reinforcers and arbitrary reinforcers can also be incorporated.

When considering supplementing treatment procedures with punishment strategies, clinicians should focus on using function-based punishers that are reflections of the functional reinforcers (Lerman & Toole, 2011), that is, if the presentation of an event acts as a reinforcer, then its removal can be said to act as a punisher. This also implies that if the removal of an event acts as a reinforcer, then its presentation will act as a punisher. The clinician can use this logic of the inverse relation between reinforcement and punishment when including supplemental procedures to reduce the reliance on powerful punishers that are likely to be highly aversive and socially unacceptable.

It is also important to point out that punishment should only be considered as a last resort to be used when function-based and other supplemental procedures have failed. In fact, it is likely to be beneficial to design any treatment for challenging behavior to begin with in a trauma-informed framework. Many individuals are likely to experience adverse childhood experiences that could contribute to trauma, and the prevalence only increases among those with intellectual and developmental disabilities (Hibbard et al., 2007; Kerns et al., 2015). Trauma-informed care remains a relatively new topic in the field of ABA and has only recently been considered in application to a very specific set of functional analysis procedures (see Iovino et al., 2022). Although ABA has yet to develop any concrete comprehensive assessment and treatment models incorporating a trauma-informed framework, there are four core commitments that can help guide clinicians in their own practice (Rajaraman et al., 2022).

One of the core commitments is to, first and foremost, acknowledge that trauma exists and that it can, not only have an impact on someone's life, but can impact everyone differently. On many occasions, aggression and tantrums can even be an externalized symptom of experiences with trauma (Bevilacqua et al., 2012; Brenner et al., 2018). A clinician who acknowledges the potential for trauma may more readily avoid using intensive procedures and attempt to inform themselves of the child's experiences. Simply behaving more cautiously among a population at risk of traumatization is likely to help clinicians avoid the possibility of re-traumatization. A second core commitment is to prioritize a safe environment, physically and emotionally, where a child can build trust with the clinician. A safe environment refers to the minimization of aversive stimuli and unpredictable threats, where the child feels comfortable enough to independently approach clinicians and communicate for reinforcers. It is doubtful that the clinician has built a level of trust with the child if they repeatedly attempt to escape or avoid the intended therapeutic environment. The third core commitment is to promote choice and shared governance throughout the assessment and treatment process. This translates to procedures such as allowing the child to choose preferred stimuli to bring into therapy sessions, leaving the door open so the child can physically leave if they feel uncomfortable, and providing the child with a voice to formalize their wants and needs. The fourth core commitment is to focus on skill building during treatment. A comprehensive repertoire of skills is often needed in order to overcome or adapt to trauma. Thus, the road to treating aggression and tantrums with behavioral strategies should target an array of skills to replace challenging behavior and empower the child.

Conclusions

Children diagnosed with ASD may engage in aggression and tantrums as a way to interact socially with their environment (e.g., to gain access to a preferred item or to remove something nonpreferred). A considerable number of studies have evaluated treatments of aggressive behavior exhibited by children with ASD, and the vast majority have indicated that treatments based on the principles of ABA are the most robust and efficacious (Durand & Moskowitz, 2015), and are superior to pharmacological interventions alone in most cases (Matson & Jang, 2014). Treatments such as the comprehensive function-based package are generally effective when implemented with high procedural integrity and are likely an appropriate initial approach to the treatment of aggression and tantrums following a formal functional assessment. Moreover, it is important that clinicians continue to plan for generalization and maintenance at the onset according to current best practices, which may in turn increase the social acceptability of behavioral treatments.

References

Ala'i-Rosales, S., Cihon, J. H., Currier, T. D. R., Ferguson, J. L., Leaf, J. B., Leaf, R., McEachin, J., & Weinkauf, S. M. (2019). The big four: Functional assessment research informs preventative behavior analysis. *Behavior Analysis in Practice, 12*(1), 222–234. https://doi.org/10.1007/s40617-018-00291-9

Aman, M. G., & Singh, N. N. (1986). Aberrant Behavior Checklist: Manual. E. Aurora, NY: Slosson.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, C. M., & Long, E. S. (2002). Use of a structured descriptive assessment methodology to identify variables affecting problem behavior. *Journal of Applied Behavior Analysis, 35*(2), 137–154. https://doi.org/10.1901/jaba.2002.35-137

Antonacci, D. J., Manuel, C., & Davis, E. (2008). Diagnosis and treatment of aggression in individuals with developmental disabilities. *Psychiatric Quarterly, 79*(3), 225–247. https://doi.org/10.1007/s11126-008-9080-4

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 1–21. https://doi.org/10.1002/jaba.30

Bevilacqua, L., Carli, V., Sarchiapone, M., George, D. K., Goldman, D., Roy, A., & Enoch, M. (2012). Interaction between FKBP5 and childhood trauma and risk of aggressive behavior. *Archives of General Psychiatry, 69*(1), 62–70. https://doi.org/10.1001/archgenpsychiatry.2011.152

Brenner, J., Pan, Z., Mazefsky, C., Smith, K. A., & Gabriels, R. (2018). Behavioral symptoms of reported abuse in children and adolescents with autism spectrum disorder in inpatient settings. *Journal of Autism and Developmental Disorders, 48*, 3727–3725. https://doi.org/10.1007/s10803-017-3183-4

Brosnan, J., & Healy, O. (2011). A review of behavioral interventions for the treatment of aggression in individuals with developmental disabilities. *Research in Developmental Disabilities, 32*(2), 437–446. https://doi.org/10.1016/j.ridd.2010.12.023

Campbell, J. M. (2003). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: A quantitative synthesis of single-subject research. *Research in Developmental Disabilities, 24*(2), 120–138. https://doi.org/10.1016/S0891-4222(03)00014-3

Carr, E. G. (1994). Emerging themes in the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 27*, 393–399. https://doi.org/10.1901/jaba.1994.27-393

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis, 18*(2), 111–126. https://doi.org/10.1901/jaba.1985.18-111

Dagnan, D., & Weston, C. (2006). Physical intervention with people with intellectual disabilities: The influence of cognitive and emotional variables. *Journal of Applied Research in Intellectual Disabilities, 19*(2), 219–222. https://doi.org/10.1111/j.1468-3148.2005.00262.x

Dorsey, M. F., & Harper, J. M. (2018). Toward the scientist practitioner model in applied behavior analysis: Examples of a science-based practice. *Education and Treatment of Children, 41*(3), 273–275. https://doi.org/10.1353/etc.2018.0013

Durand, V. M., & Moskowitz, L. (2015). Functional communication training. *Topics in Early Childhood Special Education, 35*(2), 116–126. https://doi.org/10.1177/0271121415569509

Farmer, C. A., & Aman, M. G. (2011). Aggressive behavior in a sample of children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 5*(1), 317–323. https://doi.org/10.1016/j.rasd.2010.04.014

Farmer, C., Butter, E., Mazurek, M. O., Cowan, C., Lainhart, J., Cook, E. H., et al. (2015). Aggression in children with autism spectrum disorders and a clinic-referred comparison group. *Autism, 19*(3), 281–291. https://doi.org/10.1177/1362361313518995

Fiani, T., & Jessel, J. (2022). Practical functional assessment and behavioral treatment of challenging behavior for clinically based outpatient services: A consecutive case series evaluation. *Education and Treatment of Children, 45*, 211–230. https://doi.org/10.1002/bin.1640

Fitzpatrick, S. E., Srivorakiat, L., Wink, L. K., Pedapati, E. V., & Erickson, C. A. (2016). Aggression in autism spectrum disorder: Presentation and treatment options. *Neuropsychiatric Disease and Treatment, 12*, 1525–1538.

Fletcher, P. C., Markoulakis, R., & Bryden, P. J. (2012). The costs of caring for a child with an autism spectrum disorder. *Issues in Comprehensive Pediatric Nursing, 35*(1), 45–69. https://doi.org/10.3109/01460862.2012.645407

Frye, R. E., & Rossignol, D. A. (2016). Identification and treatment of pathophysiological comorbidities of autism spectrum disorder to achieve optimal outcomes. *Clinical Medicine Insights: Pediatrics, 10*(1), 43–56. https://doi.org/10.4137/CMPed.S38337

Fryling, M. J., & Baires, N. A. (2016). The practical importance of the distinction between open and closed-ended indirect assessments. *Behavior Analysis in Practice, 9*(2), 146–151. https://doi.org/10.1007/s40617-016-0115-2

Ghaemmaghami, M., Hanley, G. P., Jessel, J., & Landa, R. (2018). Shaping complex functional communication responses. *Journal of Applied Behavior Analysis, 51*(3), 502–520. https://doi.org/10.1002/jaba.468

Ghaemmaghami, M., Hanley, G. P., & Jessel, J. (2021). Functional communication training: From efficacy to effectiveness. *Journal of Applied Behavior Analysis, 54*(1), 122–143. https://doi.org/10.1002/jaba.762

Hagopian, L. P., Boelter, E. W., & Jarmolowicz, D. P. (2011). Reinforcement schedule thinning following functional communication training: Review and recommendations. *Behavior Analysis in Practice, 4*, 4–16. https://doi.org/10.1007/BF03391770

Hagopian, L. P., Dozier, C. L., Rooker, G. W., & Jones, B. A. (2013). Assessment and treatment of severe problem behavior. In G. J. Madden, W. V. Dube, T. D. Hackenberg, G. P. Hanley, & K. A. Lattal (Eds.), *APA handbook of behavior analysis: Vol. 2. Translating principles into practice* (pp. 353–386). American Psychological Association. https://doi.org/10.1037/13938-014

Hagopian, L. P., Rooker, G. W., & Zarcone, J. R. (2015). Delineating subtypes of self-injurious behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 48*(3), 523–543. https://doi.org/10.1002/jaba.236

Hagopian, L. P., Rooker, G. W., Zarcone, J. R., Bonner, A. C., & Arevalo, A. R. (2017). Further analysis of subtypes of automatically reinforced SIB: A replication and quantitative analysis of published datasets. *Journal of Applied Behavior Analysis, 50*(1), 48–66. https://doi.org/10.1002/jaba.368

Hanley, G. P. (2012). Functional assessment of problem behavior: Dispelling myths, overcoming implementation obstacles, and developing new lore. *Behavior Analysis in Practice, 5*(1), 54–72. https://doi.org/10.1007/BF03391818

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis, 34*(1), 17–38. https://doi.org/10.1901/jaba.2001.34-17

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36*(2), 147–185. https://doi.org/10.1901/jaba.2003.36-147

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47*(1), 16–36. https://doi.org/10.1002/jaba.106

Hartley, S. L., Sikora, D. M., & McCoy, R. (2008). Prevalence and risk factors of maladaptive behaviour in young children with autistic disorder. *Journal of Intellectual Disability Research, 52*(10), 819–829. https://doi.org/10.1111/j.1365-2788.2008.01065.x

Hayes, S. C., Nelson, R. O., & Jarrett, R. B. (1987). The treatment utility of assessment: A functional approach to evaluating assessment quality. *American Psychologist, 42*(11), 963–974. https://doi.org/10.1037/0003-066X.42.11.963

Herzinger, C. V., & Campbell, J. M. (2007). Comparing functional assessment methodologies: A quantitative synthesis. *Journal of Autism and Developmental*

Disorders, 37(8), 1430–1445. https://doi.org/10.1007/s10803-006-0219-6

Heyvaert, M., Saenen, L., Campbell, J. M., Maes, B., & Onghena, P. (2014). Efficacy of behavioral interventions for reducing problem behavior in persons with autism: An updated quantitative synthesis of single-subject research. *Research in Developmental Disabilities, 35*(10), 2463–2476. https://doi.org/10.1016/j.ridd.2014.06.017

Hibbard, R. A., Desch, L. W., & Committee on Child Abuse and Neglect. (2007). Maltreatment of children with disabilities. *Pediatrics, 119*(5), 1018–1025. https://doi.org/10.1542/peds.2007-0565

Hodgetts, S., Nicholas, D., & Zwaigenbaum, L. (2013). Home sweet home? Families' experiences with aggression in children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 28*(3), 166–174. https://doi.org/10.1177/1088357612472932

Holden, B., & Gitlesen, J. P. (2006). A total population study of challenging behaviour in the county of Hedmark Norway: Prevalence, and risk markers. *Research in Developmental Disabilities, 27*, 456–465. https://doi.org/10.1016/j.ridd.2005.06.001

Iovino, L., Canniello, F., Simeoli, R., Gallucci, M., Benincasa, R., D'Elia, D., Hanley, G. P., & Cammilleri, A. (2022). A new adaptation of the interview-informed synthesized contingency analyses (IISCA): The performance-based IISCA. *European Journal of Behavior Analysis, 23*(2), 144–155. https://doi.org/10.1080/15021149.2022.2093596

Iwata, B. A., Pace, G. M., Dorsey, M. F., Zarcone, J. R., Vollmer, T. R., Smith, R. G., Rodgers, T. A., Lerman, D. C., Shore, B. A., Mazaleski, J. L., Goh, H., Cowdery, G. E., Kalsher, M. J., McCosh, K. C., & Willis, K. D. (1994). The functions of self-injurious behavior: An experimental-epidemiological analysis. *Journal of Applied Behavior Analysis, 27*(2), 215–240. https://doi.org/10.1901/jaba.1994.27-215

Jessel, J. (2022). Practical functional assessment. In J. B. Leaf, J. H. Cihon, J. L. Ferguson, & M. J. Weiss (Eds.), *Handbook of applied behavior analysis interventions for autism*. Springer. https://doi.org/10.1007/978-3-030-96478-8_23

Jessel, J., & Ingvarsson, E. T. (2016). Recent advances in applied research on DRO procedures. *Journal of Applied Behavior Analysis, 49*(4), 991–995. https://doi.org/10.1002/jaba.323

Jessel, J., Borrero, J. C., & Becraft, J. L. (2015). Differential reinforcement of other behavior increases untargeted behavior. *Journal of Applied Behavior Analysis, 48*(2), 402–416. https://doi.org/10.1002/jaba.204

Jessel, J., Ingvarsson, E. T., Metras, R., Kirk, H., & Whipple, R. (2018). Achieving socially significant reductions in problem behavior following the interview-informed synthesized contingency analysis: A summary of 25 outpatient applications. *Journal of Applied Behavior Analysis, 51*(1), 130–157. https://doi.org/10.1002/jaba.436

Jessel, J., Hanley, G. P., & Ghaemmaghami, M. (2020). On the standardization of the functional analysis. *Behavior Analysis in Practice, 13*(1), 205–216. https://doi.org/10.1007/s40617-019-00366-1

Kahng, S. W., Iwata, B. A., Thompson, R. H., & Hanley, G. P. (2000). A method for identifying satiation versus extinction effects under noncontingent reinforcement schedules. *Journal of Applied Behavior Analysis, 33*(4), 419–432. https://doi.org/10.1901/jaba.2000.33-419

Kanne, S. M., & Mazurek, M. O. (2011). Aggression in children and adolescents with ASD: Prevalence and risk factors. *Journal of Autism and Developmental Disorders, 41*(7), 926–937.

Kerns, C. M., Newschaffer, C. J., & Berkowitz, S. J. (2015). Traumatic childhood events and autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*(11), 3475–3486. https://doi.org/10.1007/s10803-015-2392-y

Kodak, T., Northup, J., & Kelley, M. E. (2007). An evaluation of the types of attention that maintain problem behavior. *Journal of Applied Behavior Analysis, 40*(1), 167–171. https://doi.org/10.1901/jaba.2007.43-06

Kratochwill, T. R., & Shapiro, E. S. (2000). Conceptual foundations of behavioral assessment in schools. In E. S. Shapiro & T. R. Kratochwill (Eds.), *Behavioral assessment in schools* (pp. 3–15). The Guilford Press.

Kurtz, P. F., Boelter, E. W., Jarmolowicz, D. P., Chin, M. D., & Hagopian, L. P. (2011). An analysis of functional communication training as an empirically supported treatment for problem behavior displayed by individuals with intellectual disabilities. *Research in Developmental Disabilities, 32*(6), 2935–2942. https://doi.org/10.1016/j.ridd.2011.05.009

Lalli, J. S., Casey, S., & Kates, K. (1995). Reducing escape behavior and increasing task completion with functional communication training, extinction, and response chaining. *Journal of Applied Behavior Analysis, 28*(3), 261–268. https://doi.org/10.1901/jaba.1995.28-261

Lam, K. S. L., Aman, M. G., & Arnold, L. E. (2006). Neurochemical correlates of autistic disorder: A review of the literature. *Research in Developmental Disabilities, 27*(3), 254–289. https://doi.org/10.1016/j.ridd.2005.03.003

Lattal, K. A., St. Peter, C., & Escobar, R. (2013). Operant extinction: Elimination and generation of behavior. In G. J. Madden, W. V. Dube, T. D. Hackenberg, G. P. Hanley, & K. A. Lattal (Eds.), *APA handbook of behavior analysis. Vol. 2: Translating principles into practice* (pp. 77–107). APA. https://doi.org/10.1037/13938-004

Lecavalier, L., Leone, S., & Wiltz, J. (2006). The impact of behaviour problems on caregiver stress in young people with autism spectrum disorders. *Journal of Intellectual Disability Research, 50*(3), 172–183. https://doi.org/10.1111/j.1365-2788.2005.00732.x

Lerman, D. C., & Toole, L. M. (2011). Developing function-based punishment procedures for problem behavior. In W. W. Fisher, C. C. Piazza, & H. S. Roane (Eds.), *Handbook of applied behavior analysis* (2nd ed., pp. 352–373). The Guilford Press.

Lunsky, Y., Khuu, W., Tadrous, M., Vigod, S., Cobigo, V., & Gomes, T. (2017). Antipsychotic use with and without comorbid psychiatric diagnosis among adults with intellectual and developmental disabilities. *The Canadian Journal of Psychiatry, 63*, 361–369. https://doi.org/10.1177/0706743717727240

Matson, J. L., & Adams, H. L. (2014). Characteristics of aggression among persons with autism spectrum disorders. *Research in Autism Spectrum Disorders, 8*(11), 1578–1584. https://doi.org/10.1016/j.rasd.2014.08.004

Matson, J. L., & Jang, J. (2014). Treating aggression in persons with autism spectrum disorders: A review. *Research in Developmental Disabilities, 35*(12), 3386–3391. https://doi.org/10.1016/j.ridd.2014.08.025

Mazurek, M. O., Kanne, S. M., & Wodka, E. L. (2013). Physical aggression in children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*(3), 455–465.

McGillivray, J. A., & McCabe, M. P. (2004). Pharmacological management of challenging behaviour of individuals with intellectual disability. *Research in Developmental Disabilities, 25*, 523–537. https://doi.org/10.1016/j.ridd.2004.03.001

Mulligan, C. K., & Trauner, D. A. (2014). Incidence and behavioral correlates of epileptiform abnormalities in autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*(2), 452–458. https://doi.org/10.1007/s10803-013-1888-6

Murphy, O., Healy, O., & Leader, G. (2009). Risk factors for challenging behaviors among 157 children with autism spectrum disorder in Ireland. *Research in Autism Spectrum Disorders, 3*(2), 474–482. https://doi.org/10.1016/j.rasd.2008.09.008

Nicotera, A. G., Hagerman, R. J., Catania, M. V., Buono, S., Nuovo, S. D., Liprino, E. M., Stracuzzi, E., Giusto, S., Di Vita, G., & Musumeci, S. A. (2019). EEG abnormalities as a neurophysiological biomarker of severity in autism spectrum disorder: A pilot cohort study. *Journal of Autism and Developmental Disorders, 49*(6), 2337–2347. https://doi.org/10.1007/s10803-019-03908-2

Otero-López, J. M., Castro, C., Villardefrancos, E., & Santiago, M. J. (2009). Job dissatisfaction and burnout in secondary school teachers: student's disruptive behaviour and conflict management examined. *European Journal of Education and Psychology, 2*(2), 99–111.

Potegal, M., & Davidson, R. J. (2003). Temper tantrums in young children: 1. Behavioral composition. *Journal of Developmental & Behavioral Pediatrics, 24*(3), 140–147.

Rajaraman, A., Austin, J. L., Gover, H. C., Cammilleri, A. P., Donnelly, D. R., & Hanley, G. P. (2022). Toward trauma-informed applications of behavior analysis. *Journal of Applied Behavior Analysis, 55*(1), 40–61. https://doi.org/10.1002/jaba.881

Ray, B., Long, J. M., Sokol, D. K., & Lahiri, D. K. (2011). Increased secreted amyloid precursor protein-α (sAPP α) in severe autism: Proposal of a specific, anabolic pathway and putative biomarker. *PLoS One, 6*(6), e20405. https://doi.org/10.1371/journal.pone.0020405

Reese, R. M., Richman, D. M., Belmont, J. M., & Morse, P. (2005). Functional characteristics of disruptive behavior in developmentally disabled children with and without autism. *Journal of Autism and Developmental Disorders, 35*(4), 419–428. https://doi.org/10.1007/s10803-005-5032-0

Ringdahl, J. E., Kopelman, T., & Falcomata, T. S. (2009). Applied behavior analysis and its application to autism and autism related disorders. In *Applied behavior analysis for children with autism spectrum disorders* (pp. 15–32). Springer.

Rojahn, J., Schroeder, S., & Hoch, T. (2007). *Self-injurious behavior in intellectual disabilities* (Vol. 2). Elsevier.

Rooker, G. W., Iwata, B. A., Harper, J. M., Fahmie, T. A., & Camp, E. M. (2011). False-positive tangible outcomes of functional analyses. *Journal of Applied Behavior Analysis, 44*(4), 737–745. https://doi.org/10.1901/jaba.2011.44-737

Rooker, G. W., Jessel, J., Kurtz, P. F., & Hagopian, L. P. (2013). Functional communication training with and without alternative reinforcement and punishment: An analysis of 58 applications. *Journal of Applied Behavior Analysis, 46*(4), 708–722. https://doi.org/10.1002/jaba.76

Rose, J. C., & Beaulieu, L. (2019). Assessing the generality and durability of interview-informed functional analyses and treatment. *Journal of Applied Behavior Analysis, 52*(1), 271–285. https://doi.org/10.1002/jaba.504

Saini, V., Greer, B. D., & Fisher, W. W. (2015). Clarifying inconclusive functional analysis results: Assessment and treatment of automatically reinforced aggression. *Journal of Applied Behavior Analysis, 48*(2), 315–330. https://doi.org/10.1002/jaba.203

Schlichenmeyer, K. J., Roscoe, E. M., Rooker, G. W., Wheeler, E. E., & Dube, W. V. (2013). Idiosyncratic variables that affect functional analysis outcomes: A review (2001–2010). *Journal of Applied Behavior Analysis, 46*(1), 339–348. https://doi.org/10.1002/jaba.12

Shirley, M. J., Iwata, B. A., & Kahng, S. W. (1999). False-positive maintenance of self-injurious behavior by access to tangible reinforcers. *Journal of Applied Behavior Analysis, 32*(2), 201–204. https://doi.org/10.1901/jaba.1999.32-201

Slaton, J. D., & Hanley, G. P. (2018). Nature and scope of synthesis in functional analysis and treatment of problem behavior. *Journal of Applied Behavior Analysis, 51*(4), 943–973. https://doi.org/10.1002/jaba.498

Solter, A. (1992). Understanding tears and tantrums. *Young Children, 47*(4), 64–68.

Sourander, A., Ellilä, H., Välimäki, M., & Piha, J. (2002). Use of holding, restraints, seclusion and time-out in child and adolescent psychiatric in-patient treatment. *European Child & Adolescent Psychiatry, 11*(4), 162–167. https://doi.org/10.1007/s00787-002-0274-2

Sturmey, P. (1994). Assessing the functions of aberrant behaviors: A review of psychometric instruments. *Journal of Autism and Developmental Disorders, 24*(3), 293–304. https://doi.org/10.1007/BF02172228

Szatmari, P., Georgiades, S., Duku, E., Bennett, T. A., Bryson, S., Fombonne, E., et al. (2015). Developmental trajectories of symptom severity and adaptive functioning in an inception cohort of preschool children with autism spectrum disorder. *JAMA Psychiatry, 72*(3), 276–283. https://doi.org/10.1001/jamapsychiatry.2014.2463

Taylor, S. A., Phillips, K. J., & Gertzog, M. G. (2018). Use of synthesized analysis and informed treatment to promote school reintegration. *Behavioral Interventions, 33*(4), 364–379. https://doi.org/10.1002/bin.1640

Thompson, R. H., Fisher, W. W., Piazza, C. C., & Kuhn, D. E. (1998). The evaluation and treatment of aggression maintained by attention and automatic reinforcement. *Journal of Applied Behavior Analysis, 31*(1), 103–116. https://doi.org/10.1901/jaba.1998.31-103

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice, 1*, 16–23. https://doi.org/10.1007/BF03391716

Tint, A., & Weiss, J. A. (2016). Family wellbeing of individuals with autism spectrum disorder: A scoping review. *Autism, 20*(3), 262–275. https://doi.org/10.1177/1362361315580442

Tremblay, R. E., Nagin, D. S., Séguin, J. R., Zoccolillo, M., Zelazo, P. D., Boivin, M., et al. (2004). Physical aggression during early childhood: Trajectories and predictors. *Pediatrics, 114*(1), e43–e50. https://doi.org/10.1542/peds.114.1.e43

Vollmer, T. R., Ringdahl, J. E., Roane, H. S., & Marcus, B. A. (1997). Negative side effects of noncontingent reinforcement. *Journal of Applied Behavior Analysis, 30*(1), 161–164. https://doi.org/10.1901/jaba.1997.30-161

Vollmer, T. R., Borrero, J. C., Wright, C. S., Van Camp, C., & Lalli, J. S. (2001). Identifying possible contingencies during descriptive analyses of severe behavior disorders. *Journal of Applied Behavior Analysis, 34*(3), 269–287. https://doi.org/10.1901/jaba.2001.34-269

Ward, S. N., Hanley, G. P., Warner, C. A., & Gage, E. E. (2021). Does teaching an omnibus mand preclude the development of specifying mands? *Journal of Applied Behavior Analysis, 54*(1), 248–269. https://doi.org/10.1002/jaba.784

Wolf, M. M. (1978). Social validity: The case for subjective measurement or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis, 11*(2), 203–214. https://doi.org/10.1901/jaba.1978.11-203

Noncompliance

16

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Introduction

According to the Merriam-Webster dictionary (n.d.), the term noncompliance describes a "failure or refusal to comply with something (such as a rule or regulation)." For example, a child may fail to follow the instructions to finish an academic task from a teacher or to complete a request from a caregiver. Researchers also use the term to refer to the failure to adhere to medical and dental procedures or instructions (e.g., Kleinsinger, 2003; Kupzyk et al., 2021; Kupzyk & Allen, 2019). In itself, noncompliance is not a behavior, but rather the absence of an expected response (i.e., the failure to comply). That said, children may engage in challenging behavior such as verbal protests, screaming, or aggression as a part of noncompliance. The initial instruction, rule, or expectation encompasses a specific stimulus condition that evokes the onset of behavior (Lambert et al., 2017). Such stimulus conditions may have aversive properties that create a state leading to noncompliance. Within this context, the absence of behavior is problematic because compliance may enhance health, social development, education, and well-being.

The problem of child noncompliance has long been investigated by researchers and clinical professionals across fields. Kalb and Loeber (2003) describe persistent noncompliance demonstrated by children across various settings and with various adults to have deleterious effects. The inability to adhere to explicit rules or expectations may create: (a) ongoing negative interactions with the adults in their lives impacting the quality of that relationship, (b) barriers accessing structured activities (e.g., sports and games) and social events with friends, (c) difficulties in making or keeping friendships with children who are generally cooperative, (d) impediments in the acquisition of academic skills, and (e) vulnerabilities to physical safety and well-being. Kalb and Loeber further report that repertoires of noncompliance commonly persist from childhood into adolescence, creating greater risks for the negative impacts of noncompliance observed in youth, such as delinquency, aggression, and violence. Moreover, Feldman (2007) showed that noncompliance in toddlers may be an early indicator of adolescents who do not develop empathy skills.

Reports on the prevalence of noncompliance vary depending on the setting and source of data. For example, cross-sectional studies have reported that noncompliance affects 25–65% of children, whereas a single nine-year longitudinal population-based study estimated a prevalence of noncompliance in the range of 3–12% in boys after adjusting for their at-risk status (Kalb & Loeber, 2003). Unsurprisingly, the prevalence of noncompliance is reported to be much higher for children referred to clinics, which ranged from 65% to 92%, when compared to nonclinical population samples with a range of 10–57% (Achenbach & Edelbrock, 1981; Kalb & Loeber, 2003). More recently, a study using formal school discipline reports found noncompliance for 25–37% of students in the 2011–2012 school year across 10 states (Losinski et al., 2017). One aspect that has been highly consistent across studies is the finding that children with autism spectrum disorders have shown higher levels of noncompliance and fewer improvements in developing compliant or cooperative skills compared to their nonautistic peers. Thus, children with autism are at greater risk for the adverse outcomes associated with noncompliance (Bryce & Jahromi, 2013; Ekas et al., 2017).

As noncompliance involves the failure to comply, practitioners and researchers often directly target compliance for intervention when addressing behaviors described as noncompliance (e.g., Dufour & Lanovaz, 2020; Wilder et al., 2020). Despite the common use of the term "compliance" in the scientific literature (i.e., behavioral, medical), the lay interpretation of this term connotes subservience (Brunton, 2017; Vermeire et al., 2001). That said, compliance is an essential component of intervening with children with autism. Interventions may or may not always involve the preference of individuals if that person is not able to make reasonable judgements that positively affect their well-being. A person with limited capacity, intellectually or developmentally, may select behaviors that could have profound negative impacts on their life.

For example, a young child, regardless of diagnosis, may select ice cream rather than vegetables as part of their dinner, or choose not to brush their teeth daily, if at all. Young children do not yet have the skills to make informed and rational decisions about the entirety of their treatment or be able to fully consent (Morris et al., 2021a). The inability to be fully involved in their own treatment is further compounded when the behavior of concern is noncompliance or when the individual has a developmental disability that affects their comprehension of the nature, benefits, or drawbacks of an intervention. As an alternative to *compliance*, we propose the term *cooperation*, which conveys working toward a mutual goal: the benefit of the child. This terminology shift addresses the longstanding concern of behavior analysts with addressing behaviors that lead to outcomes which are socially important (Baer et al., 1968), that support habilitation, and that preserve the dignity of the individuals served (Bannerman et al., 1990; Favell et al., 1984; Leaf et al., 2021; Van Houten et al., 1988). As with compliance, cooperation involves engaging in an expected behavior under specific stimulus situations (Donaldson et al., 2014; Lambert et al., 2017).

In behavior analysis, noncompliance is conceptualized in terms of antecedents (stimuli or events that precede noncompliance), behavior (topographies of compliance), and consequences (stimuli or events that maintain noncompliance). Antecedents and consequences are the environmental factors that are responsible for the occurrence of noncompliance. As such, a caregiver, teacher, or clinical professional may manipulate antecedents and consequences to prevent or attenuate ongoing noncompliance. Note that antecedents may also involve factors related to a person's internal state (e.g., feeling of anxiety, hormonal state, fatigue), which behavior analysts refer to as motivating operations. Guided by a professional in behavior analysis, caregivers and other practitioners (e.g., teachers, behavior technicians) will measure and collect data on the topography of noncompliant and cooperative behavior, so that the relevant antecedents and consequences may be identified. The professional will then consider and recommend intervention options that may involve systematic changes to antecedents, consequences, or both. The main goal of treatments for noncompliance is to systematically reframe a situation so that the same stimulus or event that historically leads to noncompliance instead evokes cooperation. The purpose of this chapter is to review these assessments and behavioral interventions to support active and passive cooperation in children with autism.

Functional Assessment

Regardless of the type of cooperation, practitioners typically conduct a functional behavior assessment prior to intervening with children with autism. Functional behavior assessment involves the identification of the environmental variables that maintain challenging behavior. Specifically, the assessment provides information about the antecedents and consequences that influence behavior. Behavior analysts use this information to develop a treatment that directly addresses the function of behavior. Because functional behavior assessment was designed to assess challenging behavior, the assessment generally targets the function of noncompliance (rather than cooperation). Topographically, noncompliance may look like the child is escaping from a task, an instruction or an aversive stimulus (e.g., medical device) that is presented by a caregiver, teacher or other professional, but assuming an escape function poses a major issue for treatment. Misunderstanding the functions of behavior may lead to interventions that are contraindicated (Donaldson & Austin, 2017; Rodriguez et al., 2010).

For example, assume that a behavior analyst prescribes a time-out procedure for every instance that a child is not following specific instructions, but that noncompliance is in fact maintained by social negative reinforcement in the form of escape. We would consider this intervention as being contraindicated. Time-out is unlikely to produce the desired behavior change because the child's noncompliance will continue to be reinforced by escape. In contrast, this same intervention would most likely reduce noncompliance maintained by attention. In another example, an intervention involving the delivery of attention is less likely to be effective for the treatment of noncompliance if a child's noncompliance is reinforced by social positive reinforcement in the form of attention. Some studies have even found that access to tangibles may maintain noncompliance (Majdalany et al., 2017; Wilder et al., 2007a). To address these issues, researchers and practitioners should systematically employ functional behavior assessment to individualize treatments.

Behavior analysts may conceptualize noncompliance as a skill deficit, as insufficient reinforcement, or as a lack of motivation (see motivating operations; Laraway et al., 2003; Majdalany et al., 2017). As such, interventions will differ depending on the variables influencing noncompliance. The function-based treatment will involve eliminating or minimizing the reinforcer for noncompliance and allocating reinforcers for appropriate behavior. The three types of functional assessments are (a) indirect assessment, (b) descriptive assessment, and (c) functional analysis.

Indirect Assessment

Generally, an indirect assessment is conducted first to gather information about the behavior and the immediate environment. The primary methods of an indirect assessment are structured interviews, questionnaires, rating scales, and checklists (Durand & Crimmins, 1988; Hanley et al., 2014; Iwata et al., 2013; Matson et al., 2012). The purpose of using an indirect assessment is to develop an initial hypothesis about the antecedents and consequences that are related to the challenging behavior. Oftentimes, the tools used to gather information rely on verbal reports from the caregivers or teachers. In other words, the behavior of interest is not directly observed by the behavior analyst when conducting an indirect assessment. Indirect assessments have been used to hypothesize about the potential functions of noncompliance (Crowther et al., 1981; Keenan et al., 1998). Indirect assessments provide useful information and are easy to implement, but relying on data obtained from informants has some disadvantages. Some researchers have reported low reliability and validity of indirect assessment tools (Fagot & Leve, 1998; Iwata et al., 2013; Sturmey, 1994). Additionally, the information obtained from an indirect assessment are highly subjective because they are based on informant recall. Given these limitations, behavior analysts should strongly consider using other types of functional assessment in combination with indirect assessments to identify functions of noncompliance that will lead to a function-based intervention.

Descriptive Assessment

Descriptive assessments involve observing the target behavior in the environment in which it occurs such that relevant information related to the antecedents and consequences are recorded. When observing, the behavior analyst records the events that precede and follow noncompliance (Freeman et al., 2000; Lipschultz & Wilder, 2017b). Unstructured observations involve a behavior analyst observing the child's behavior as it would occur naturally in the environment (Ndoro et al., 2006). During structured observation, the behavior analyst may ask a caregiver to deliver an instruction that has a history of evoking noncompliance and observe the child's behavior in the natural environment (Stephenson & Hanley, 2010). The environment is arranged in such a way that will make noncompliance more likely, but no consequences are programmed in this situation. Researchers have assessed several methods of data collection and analysis such as narrative recording, conditional probabilities, and scatterplot to identify the relationship between behavior and environmental events with mixed findings (Anderson & Long, 2002; Call et al., 2017; Lanovaz et al., 2013; Miltenberger et al., 2019; Thompson & Iwata, 2007). Similar to indirect assessments methods, descriptive assessments alone do not identify causal relations. Nevertheless, behavior analysts may ascertain a strong hypothesis from well-designed indirect and descriptive assessments, which can then inform the treatment for noncompliance.

Functional Analysis

A functional analysis (sometimes referred to as an experimental analysis or a functional assessment with analog conditions) involves the systematic manipulation of antecedents and consequences to identify a functional relation between environmental events and behavior (Iwata et al., 1994a). Functional analyses consist of at least one test condition wherein a reinforcer is delivered contingent on challenging behavior and one control condition wherein a reinforcer is available on an independent time-based schedule (noncontingently, Iwata & Dozier, 2008). If the target behavior is higher in one or more test conditions relative to the control condition, the experimenter may draw conclusions about a functional relation. The functional analysis methodology has been adapted to a variety of topographies such as aggression, self-injurious behavior, and property destruction (see Beavers et al., 2013).

Relative to other topographies of challenging behavior, few studies have evaluated functional analysis procedures for noncompliance (Lloyd et al., 2017; Majdalany et al., 2017; Rodriguez et al., 2010; Wilder et al., 2007b). Conducting a functional analysis for topographies of challenging behavior that involve escaping a stimulus condition with known aversive properties may be inefficient and lead to unnecessary exposure to contrived conditions that evoke challenging behaviors. That said, researchers have employed escape baseline conditions to test the function of behavior (Cook et al., 2015; Dowdy et al., 2018; Dufour & Lanovaz, 2020; Richling et al., 2011). For example, Schumacher and Rapp (2011) arranged a baseline condition to measure escape responses by placing scissors within proximity to the child's head and scoring the number of responses. The number of escape responses occurred at a higher level than the sitting response. The use of a baseline condition that tests escape responses provides important information upon which an intervention can be developed. Nonetheless, researchers and practitioners should remain cautious when limiting their analysis to an escape condition. Some studies that experimentally evaluated environmental variables using noncompliance as the target behavior have found that it may be also be sensitive to positive reinforcement contingencies (Majdalany et al., 2017; McKerchar & Abby, 2012; Rodriguez et al., 2010; Wilder et al., 2007b).

Another option for identifying potent reinforcers that may be related to maintaining noncompliance when a traditional functional analysis is not viable to conduct a concurrent operant assessment (Berg et al., 2007; Finkel et al., 2003; Robinson et al., 2019). For example, Robinson et al. (2019) used a concurrent operant assessment to identify both preferences and putative maintaining reinforcers for five adolescents to increase cooperative skills related to household chores and hygiene tasks. The researchers used the highest ranked choice across three possible choices that each participant could allocate their time to in a free-operant condition. Using 5-min assessment sessions, the researchers arranged a room with two tables, each consisting of one the three choices, which were alternated within and across sessions for at least nine sessions. The choices consisted of adult interaction, tangible engagement (e.g., computer) and escape from working. Next, the reinforcer used for the cooperation intervention corresponded to the participant's most frequent choice from the assessment (i.e., computer access, adult interaction, escape coupon). All participants increased completion of requested tasks to 100% and improved their latencies to task initiation. Using a concurrent operant assessment may identify the function of behavior when evoking noncompliance is not possible or impractical (Berg et al., 2007), and may also identify effective reinforcers to increase cooperation.

Summary and Practice Recommendations for the Functional Assessment of Noncompliance

Functional analyses have shown noncompliance to be maintained by escape from tasks or instructions (e.g., Briggs et al., 2019; McKerchar & Abby, 2012; Newman et al., 2021), access to attention from others (e.g., Rodriguez et al., 2010), access to items (e.g., Brown et al., 2020), continued access to items or activities (e.g., Majdalany et al., 2017; Wilder et al., 2007a), and combinations thereof (e.g., Lloyd et al., 2017; Randall et al., 2018; Reimers et al., 1988). At this point, the reader should note that research has mainly focused on noncompliance associated to active cooperation (e.g., following instructions), but that these methodologies may also be adapted for passive cooperation (e.g., wearing a medical device). Because functions of noncompliance are idiosyncratic (e.g., Fulton et al., 2020; Wilder et al., 2007b), methods selected for teaching children cooperative behavior may vary. If noncompliance is not excessive, overly disruptive, or dangerous, bolstering best practice guidelines for instructional methods within a classroom (e.g., Donaldson & Austin, 2017) and at home (LaBrot et al., 2020; Morris et al., 2021a), or formally implementing other evidenced-based antecedent methods (i.e., high-probability instructional sequences; Losinski et al., 2017; Radley & Dart, 2016), could improve cooperative responding with minor modifications to the environment (Lipschultz & Wilder, 2017b).

Active Cooperation

Active cooperation occurs when a behavior is evoked by a specific request, instruction or prompt, engagement is initiated within a certain period of time (e.g., 10 s), and the requested behavior is carried out to completion. The onset of active cooperation occurs in response to a "demand" of some sort provided by an authority figure, such as a caregiver or teacher. For example, the adult may provide instructions to engage in an academic task (e.g., "point to the dog's tail," "complete this worksheet"), or an activity of daily living (e.g., "brush your teeth," "fold the laundry"). These skills are important to daily functioning and may serve as behavioral cusps for other repertoires. Children who follow simple instructions are more likely to (a) succeed in learning academic tasks and persist when they become challenging, (b) perform independent living skills necessary for health, hygiene, and relationships, and (c) engage in social contracts which provide opportunities for friendships, community events, and paying jobs (Bishop et al., 2013; Feldman, 2007; Kalb & Loeber, 2003). The prior observation is not to suggest that a child cannot reasonably refuse to follow a specific request, but children should cooperate with most requests in home and school settings. Active cooperation may also occur in the form of a response to a peer (e.g., "come play on the swings with me," "can I use your pail and shovel?"), which is essential for the social development of children with autism.

In practice, behavior analytic interventions often involve multi-component treatment packages, which capitalize on the benefits of several interventions and result in the most robust effects (Bellipanni et al., 2013; Fischetti et al., 2012; Randall et al., 2018; Wilder et al., 2020). These multi-component interventions usually include both antecedent and consequent components. To facilitate the review of each component, what follows is a description of various interventions within each of these two categories (i.e., antecedent and consequent interventions).

Antecedent Interventions

Antecedent interventions involve environmental manipulations that can attenuate persistent challenging behavior via prevention (Donaldson & Austin, 2017; Radley & Dart, 2016; Wood et al., 2018). By manipulating discriminative stimuli or motivating operations, behavior analysts may delay, or even prevent, the onset of noncompliance (Cooper et al., 2020; Miltenberger, 2016). With antecedent interventions, the reinforcer that maintains noncompliance (e.g., attention, tangibles, escape) is available independently of the occurrence of noncompliance or cooperation, and the potency of the reinforcer is diminished so that it does not necessitate noncompliance from the child's perspective (e.g., academic tasks are made easier or more engaging so that escape from tasks is no longer as valuable). In short, multiple opportunities are systematically arranged for children to freely or easily contact preferred items and activities (including maintaining reinforcers), while the likelihood of contacting aversive scenarios is minimized. From an ethical standpoint, this type of arrangement is considered a least-restrictive intervention for a first-line approach (Behavior Analyst Certification Board, 2014).

High-Probability Instructional Sequence

Researchers consider the high-probability instructional sequence (HPIS) as an evidenced-based intervention for children with autism (Brosh et al., 2018). The HPIS is the most researched, and sometimes identified as the most efficacious, intervention for promoting child cooperation (Losinski et al., 2017; Radley & Dart, 2016). During the HPIS, the caregiver or teacher delivers a series of instructions in quick succession that have a high probability (high-*p*) of producing immediate cooperation, followed by a single instruction that has a low probability (low-*p*) to evoke cooperation (Mace et al., 1988). The HPIS procedure is derived from behavioral momentum theory (Nevin, 1996), which posits that low-probability (low-*p*) behaviors are more likely to occur following a series of high-probability (high-*p*) behaviors that produce a high rate of reinforcement. In turn, the resulting state of behavioral persistence creates resistance to disrupters that occasion behavior change.

Regardless of assertions questioning the role of behavioral momentum as the primary mechanism responsible for the effects of HPIS procedures (e.g., King et al., 2021; Nevin, 1996), studies have shown that reinforcement plays a central role in the success of HPIS procedures (Pitts & Dymond, 2012; Wilder et al., 2015; Zuluaga & Normand, 2008). For instance, Wilder et al. (2015) used a reversal design across two experiments demonstrating that cooperation from two participants resulted from HPIS when edible reinforcement followed the high-*p* instructions. The researchers did not observe the same results when reinforcement was not delivered for cooperation with the high-*p* instructions or when only low-quality reinforcement (i.e., praise) was provided. The latter observation is especially important because praise is a common reinforcer during HPIS procedures, but it may reduce the effectiveness of the HPIS if it is considered as a low-quality reinforcer for a child. As such, practitioners should conduct brief preference assessments with the child (e.g., Call et al., 2012; Carr et al., 2000) to identify stimuli likely to function as reinforcers prior to intervention. Because the intervals between each instruction delivery should be brief in the HPIS (see below), practitioners should prioritize reinforcers with a brief "consumption" period (e.g., small edible, bubbles, tickles, stickers). Alternatively, practitioners may use a cumulative reinforcer system (e.g., collecting pieces for a preferred puzzle, tokens for a larger or longer back-up reinforcer) when secondary reinforcers have been empirically validated as an effective intervention for the child.

As with reinforcers, the type of instructions used for the low-*p* and high-*p* categories should be assessed and validated before they are used in the HPIS procedure (e.g., Belfiore et al., 2008; Ducharme & Worling, 1994; Ertel et al., 2019). Some examples of instructions that may be categorized as high-*p* include "close the door," "point to the window," or "show me your eyes," while low-*p* instructions may consist of "put your toy in the toybox," "push in your chair," or "hang up your coat." A high-*p* instruction for one child may serve as a low-*p* instruction for another child, which underlines the importance of conducting an individualized assessment beforehand.

Initially, the professional compiles a list of potential high-*p* and low-*p* instructions by providing an open-ended interview (Ertel et al., 2019) or a checklist of options (Ducharme & Worling, 1994) to adults who typically present instructions to the child. A caregiver or teacher presents the requests to the child in a few assessment sessions across days in a random order until each instruction has been presented for a total of 10 trials. The presentation of several instructions should incorporate a minimum intertrial interval (e.g., 60 s; Ducharme & Worling, 1994), and can be in a naturally occurring context relevant to the instruction (Belfiore et al., 2008; Ducharme & Worling, 1994). High-*p* instructions involve those with which the child cooperates within 10 s for 80% or more trials. By contrast, low-*p* instructions are those with which the child cooperates 40% or less of presentations. Instructions that fall between these two percentages are not used. Even though a "medium-probability" instructional sequence (MPIS) has been shown to be effective (Romano & Roll, 2000) and is sometimes recommended (e.g., Cook et al., 2019; Issarraras & Matson, 2020), practitioners should wait for further replications prior to adopting this approach.

Some other considerations for effective HPIS implementation include the ratio of high-*p* to low-*p* instructions and the intertrial interval used between high-*p* instructions. While many researchers recommend a 3:1 ratio of high-*p* to low-*p* instructions, others have found 5:1 and 1:1 ratios to be effective, though some involved fading procedures (Ertel et al., 2019). Behavioral momentum theory suggests that a higher rate of reinforcement produces a larger behavioral mass and more behavioral momentum. Hence, a higher number of high-*p* instructions for each low-*p* instruction may produce larger behavior changes. For example, Ertel et al. (2019) examined the use of 1:1, 3:1 and 5:1 ratios, and found that 5:1 ratios were the most effective at producing cooperative responding. Lastly, effective implementation of a HPIS procedure requires a brief intertrial interval (i.e., the time between the onset of one trial to the onset of the subsequent trial). Researchers have often used a 10-s intertrial interval (Bullock & Normand, 2006), but more recent studies have indicated that shorter intervals (1–5 s) may be more effective (Pitts & Dymond, 2012; Wilder et al., 2015).

Noncontingent Reinforcement

Noncontingent reinforcement (NCR) involves the noncontingent delivery of a preferred item (often stimuli that function as maintaining reinforcers) on a fixed- or variable-time schedule. The caregiver or teacher delivers the preferred item regardless of the occurrence of noncompliance or cooperation. The independent delivery of reinforcers is thought to function as an abolishing operation for noncompliance. For example, if noncompliance is maintained by attention, an adult may provide attention (e.g., "that's great coloring, Gabriela!") on a fixed-schedule (e.g., every 3 min). Besides decreasing the likelihood of challenging or disruptive behavior, NCR may also provide an overall enhanced environment for the child. For instance, some children engage in attention-seeking behavior because they have been deprived of adult interactions for a period of time, which may be especially true for children with autism. Adults tend to allocate their time to children who are engaging in disruptive behavior and spend less time interacting with those who are playing or working "nicely." To this end, studies have shown that providing noncontingent interaction or access to tangibles is an effective strategy for preventing persistent challenging behavior (Carr et al., 2009; Ingvarsson et al., 2008).

Likewise, noncontingent escape (NCE) involves providing more frequent breaks for escape-maintained behavior before an establishing operation (or "the need") for a break becomes apparent via noncompliance (e.g., Coleman & Holmes, 1998; Kodak et al., 2003a). Some studies have used NCE to effectively reduce noncompliance, but NCR with positive reinforcers tends to be a common intervention for noncompliance including instances when an escape function has been identified. Notably, Kodak et al. (2003b) found that NCE was ineffective for escape-maintained noncompliance, but when a second functional analysis determined the function was multiply controlled (escape and attention), the intervention was modified to NCE plus NCR using positive reinforcers, resulting in a decrease in noncompliance and an increase in cooperation. These results suggest that a synthesized treatment may be required for multiply-controlled behavior. Given that NCE was ineffective as a stand-alone treatment, another option may be that only NCR with attention was necessary to achieve the same effects.

In another example, Ingvarsson et al. (2008) found that NCR with positive reinforcers effectively decreased multiply-controlled noncompliance and increased cooperation. Moreover, NCR with positive reinforcers has been shown to be an effective strategy to reduce escape-maintained noncompliance and increase cooperation (e.g., Newman et al., 2021; Lomas et al., 2010). Taken together, these results indicate that NCR with positive reinforcers may be an effective intervention for children, regardless of the maintaining function of noncompliance. As with any intervention using preferences or reinforcers, practitioners should empirically identify preferred items or activities using a preference assessment (e.g., Call et al., 2012; Robinson et al., 2019), or conduct a functional assessment to confirm the maintaining reinforcers (e.g., Briggs et al., 2019; Brown et al., 2020) to produce optimal treatment effects.

A handful of studies have used noncontingent reinforcement in the form of pretrial access to directly target active cooperative responding as the primary dependent variable (Bullock & Normand, 2006; Hodges et al., 2021; Normand & Beaulieu, 2011). Noncontingent access to preferred items was provided *prior to* a trial issuing a low-*p* instruction. Bullock and Normand (2006) and Normand and Beaulieu (2011) showed increases in active cooperation for all instructions across all participants, except for one type of instruction for one participant, which involved relinquishing a video game. In a follow-up study, Lipschultz et al. (2017) were unable to replicate the results of pretrial access and HPIS intervention for two participants. Ultimately, contingent access to a highly preferred edible was required to improve cooperation with low-*p* instructions. More recently, Hodges et al. (2021) evaluated pretrial access for seven children, and found it to be an effective intervention when pretrial access was given at a higher magnitude of preferred items (5 edibles) for four children and a longer duration (3 min of iPad or toy access) for three children. Interestingly, the baseline conditions of the prior studies show that a reinforcement contingency alone was ineffective at increasing cooperation, and pretrial access to preferred stimuli clearly evoked cooperative responding. This observation is notable because providing response-dependent access may be preferable to other strategies for evoking cooperation, such as prompting, which may be aversive and evoke other challenging behavior. Unfortunately, the authors of these studies did not take data on challenging behavior, which may have provided more insight into this potential benefit of pretrial access to reinforcers.

Reducing Response Effort

In contrast with NCR that produces an abolishing operation, reducing response effort may set an establishing operation to engage in cooperation by making the cooperative response less effortful to engage in. For example, Fischetti et al. (2012)

reduced the response effort for three children to put their toy away in a bin by increasing the proximity of the bin to the child when they presented the instruction. The reduction of response effort alone increased cooperation for only one child, but those effects did not maintain as the task became more difficult (i.e., distance increased). However, the addition of edible reinforcement was sufficient to maintain cooperation as effort increased. For another participant, a guided compliance procedure (described in the consequences section) with edible reinforcement was required whereas guided compliance without the additional edible was effective for the third child.

In a similar study, Wilder et al. (2013) initially reduced response effort by decreasing the distance to a toy bin for two children, but they also provided an edible contingent on cooperation. That is, the researchers did not assess the reduction of response effort alone. The distance of the toy bin was systematically increased until it was 3 m away, and both children cooperated with instructions without any challenging behavior. The researchers also initially reduced effort for a third child without using an edible, but they found edible reinforcement was eventually required for higher levels of cooperation and low-to-no engagement in challenging behavior. Relinquishing preferred items by putting them in a toy bin may be a more difficult request to cooperate with (e.g., Normand & Beaulieu, 2011), perhaps due to the competing motivating variables. The success of a simple response effort reduction procedure combined with edible reinforcement is a surprising result. Across both studies (Fischetti et al., 2012; Wilder et al., 2013), four of the six children did not require the implementation of extinction or response guidance. Overall, response effort manipulations may be advantageous to include when targeting active cooperation for increase, especially when cooperation involves giving up a preferred item.

Manipulating the Delivery of Instructions

Researchers have extensively examined different dimensions of instruction delivery on child behavior, which are provided by the caregiver or practitioner. Notably, studies have manipulated the form of instruction (e.g., Bouxsein et al., 2008; Ducharme & Worling, 1994; Houlihan & Jones, 1990; Neef et al., 1983; Peyton et al., 2005), the schedule of instruction (DeLeon et al., 2014; Fulton et al., 2020), the required requisite responses for instruction (Hamlet et al., 1984; Stephenson & Hanley, 2010), the presence of advanced warnings (e.g., “2 min until …”; Cote et al., 2005; Wilder et al., 2007b, 2010), and the inclusion of rationales for cooperation (Wilder et al., 2010, 2012). Although the latter two strategies have been commonly recommended in parenting books (Lipschultz & Wilder, 2017a), research findings do not support these strategies as effective (e.g., Cote et al., 2005; Wilder et al., 2010, 2012, 2007b). General recommendations such as these often suggest there is a lack of “understanding” on the child’s part. The issue is that these solutions tend to overlook the function of behavior, which is idiosyncratic across children with autism who display noncompliance (Waters et al., 2009).

Similarly, several recommendations and treatment packages include descriptions about the form of instruction. Some evidence suggests that form of instruction can influence cooperative responding. For instance, one-step directive instructions (e.g., “please put your toys in the toy box”) are usually more effective in evoking cooperation than ambiguous or multi-step instructions (e.g., “wow, it’s messy in here, there are toys in the playroom and the living room!”; Bouxsein et al., 2008; Peyton et al., 2005). Moreover, “do” and “don’t” instructions appear to belong to different response classes because effective interventions that increase cooperation with one type of instruction (e.g., “come to the table” as a “do” request) does not systematically generalize to the other (e.g., “stop jumping on the couch” as a “don’t” request; Neef et al., 1983; Houlihan & Jones, 1990). For some children, framing “don’t” requests as “do” requests may produce more meaningful changes in behavior (e.g., “sit down on the couch” vs. “stop jumping on the couch”; Ducharme & Worling, 1994). Other accompanying strategies to simple directive statements are to ensure that the adult is in close proximity to the child and obtains eye contact prior to the delivery of the instruction (e.g., Hamlet et al., 1984; Stephenson & Hanley, 2010). The combination of providing directive one-step instructions with a quiet-toned voice and in close proximity, establishing eye contact, and waiting 5–10 s for cooperation are antecedent components in a treatment package known as effective instruction delivery. The package also involves the consequent component of praising cooperation, relying on both antecedent and consequent interventions. This intervention package is commonly used in classrooms (e.g., Bellipanni et al., 2013; Mandal et al., 2000) and is sometimes taught as a general strategy for caregivers (e.g., LaBrot et al., 2020).

Finally, the research literature strongly supports considerations in the schedule of instructional periods, which is directly related to the use of accumulated versus distributed reinforcement (DeLeon et al., 2014; Fulton et al., 2020). Distributed reinforcement involves briefer periods of reinforcement that are provided frequently for cooperation (dense schedules) whereas accumulated reinforcement occurs after longer working periods but prolonged access to reinforcement is provided (yoked to the total access duration in the distributed condition). The latter condition provides a leaner schedule of reinforcement with longer work periods. Studies have generally shown that accumulated reinforcement results in better cooperative responding and lower levels of challenging behavior (e.g., Fulton et al., 2020). Furthermore, most participants selected the accumulated reinforcement condition as their most preferred. In short, the tradeoff for longer working periods is receiving a higher magnitude of reinforcement. When considering the period of instruction delivery, caregivers and teachers may benefit from assessing the ratio of instruction periods to reinforcement periods. A noteworthy consideration is the skill level and history of the child, which may alter the effectiveness of using longer periods of instruction for accumulated reinforcement.

Overall, HPIS and NCR have both been identified as evidenced-based interventions (e.g., Brosh et al., 2018; Carr et al., 2009; Losinski et al., 2017; Radley & Dart, 2016), and effective instruction delivery has some support as an intervention, but there has not been consensus on its status as an evidenced-based treatment (Losinski et al., 2017; Radley & Dart, 2016). Given their nonaversive nature, these interventions should be considered as one of the first line approaches for caregivers and practitioners to use to increase child cooperation and decrease noncompliant behavior.

Consequent Interventions

Despite the relative benefits of an antecedent-only strategy, consequences are frequently required to obtain the most effective intervention effects. One approach is to begin with a practical and less restrictive intervention using antecedent strategies, and then to monitor the effects to determine if consequent interventions should be considered. If antecedent interventions are moderately effective or the behavior change does not persist, practitioners may add consequent components (e.g., Newman et al., 2021; Wilder et al., 2007b). If the antecedent intervention is ineffective, an alternative may involve taking a consequent-only approach (e.g., Fischetti et al., 2012; Lipschultz et al., 2017). To this end, many consequent procedures are beneficial on their own, and those that involve the provision of positive reinforcers (e.g., DRA) may also be considered least restrictive. Consequent interventions are designed to directly address response-reinforcer (i.e., causal) relationships. Below is a description of several consequent strategies used to decrease noncompliance and promote active cooperative responding.

Guided Compliance

Guided compliance procedures to increase active cooperation typically involve a 3-step process contingent on noncompliance, with each step progressively more intrusive (e.g., Wilder & Atwell, 2006). For the first step, the caregiver or teacher provides an instruction, which is followed by praise provided contingent on cooperation within 10 s. If the child does not comply, the caregiver or teacher re-presents the instruction and models the cooperative response (step 2). If cooperation occurs within 10 s, the child receives praise. If noncompliance persists, the caregiver or teacher physically guides the child to engage in the cooperative response using hand-over-hand prompting (step 3). Several mechanisms may explain why guided compliance effectively increases active cooperation (Tarbox et al., 2007; Wilder et al., 2012, 2020; Wilder & Atwell, 2006), including extinction (preventing escape from the requirement to cooperate), punishment (applying an aversive consequence contingent on noncompliance), and negative reinforcement (avoidance of repeated instructions and physical prompts to cooperate). A disadvantage to guided compliance is that some of the above mechanisms involve a seemingly aversive aspect. Nevertheless, guided compliance provides an instructional component to correct behavior.

Recently, Wilder et al. (2020) incorporated a highly preferred edible into the guided compliance procedure as a less aversive option. In this version of guided compliance, the caregiver or teacher presents a preferred edible by holding it up as the initial instruction is presented. Contingent on cooperation with the instruction within 10 s, the child received the edible. Wilder et al. (2020) used this procedure for instructions that were particularly difficult (relinquishing an iPad) for two boys. Interventions that involved only a preferred edible for cooperation (without the guided compliance procedure) or guided compliance for noncompliance (using praise for the initial instruction) were both ineffective. Only the combination of these interventions resulted in cooperation from both boys. Caregivers and practitioners should consider the incorporation of a highly preferred item if they chose a guided compliance procedure. To obtain best treatment outcomes, the practitioner should empirically identify the highly preferred item using a preference assessment (e.g., Call et al., 2012; Carr et al., 2000).

Differential Reinforcement of Alternative Behavior

Differential reinforcement of alternative behavior (DRA) involves providing reinforcement for one response while implementing extinction (i.e., withholding the maintaining reinforcer) for the undesirable response (e.g., Vollmer & Iwata, 1992; Miltenberger, 2016; Cooper et al., 2020). When used systematically as a procedure to reallocate responding for cooperation, only the cooperative response obtains the maintaining reinforcer while noncompliance is placed on extinction (i.e., never contacts the reinforcer). Through response reallocation, the cooperation replaces noncompliance. The type of extinction for noncompliance depends on the function of behavior, as identified in a functional analysis. If noncompliance is maintained by escape from instructions, extinction usually involves prompting follow through with the request (e.g., guided compliance procedure) that does not allow escape from the instruction.

However, studies have long evaluated the exclusion of escape extinction (e.g., Lalli et al., 1999; Piazza et al., 1997), and more recently, researchers have suggested refinements for this broad definition for DRA (Vollmer et al., 2020). Using DRA without an extinction component for teaching cooperation involves not only providing reinforcement for cooperative behavior but also permitting the child to escape the demand by not requiring follow through (and not commenting on noncompliance) or allowing continued access to the item or activity if the child was asked to relinquish access. Studies have shown that DRA interventions designed to improve cooperative responding and reduce challenging behavior without the inclusion of an extinction component may be effective (e.g., Briggs et al., 2019; Carter, 2010; Majdalany et al., 2017; Slocum & Vollmer, 2015; Wilder et al., 2007a).

Behavior analysts may decide to use a DRA procedure without extinction in cases when (a) extinction evokes aggression as well dangerous or high-intensity behavior, (b) extinction is difficult or impractical to implement (e.g., large size of child or adolescent), or (c) allowing escape may be a primary means for the child to opt out of activities important to their health, learning or development (e.g., Morris et al., 2021b; Rajaraman et al., 2021). These benefits must be weighed against the risks of excluding extinction, including ineffective outcomes (e.g., Newman et al., 2021; Wilder et al., 2020) or having positive treatment effects prone to relapse (e.g., Briggs et al., 2019; Brown et al., 2020). Vollmer et al. (2020) proposed that both the definition and the procedure of DRA should incorporate the use of minimizing reinforcement rather than the exclusive use of extinction for challenging behavior. Adjusting the relative value of reinforcement for cooperation over the competing noncompliance response can be effective at mitigating relapse concerns (Brown et al., 2020). The differential rate, quality, magnitude, and duration may have an impact on cooperation (Fulton et al., 2020; Rogalski et al., 2020).

In essence, the relative value of reinforcement for cooperation should outweigh the aversive aspects (Rogalski et al., 2020). Reinforcement rate, quality, magnitude, and or duration needs to be “worth it” before consistent cooperation may be observed. The type of reinforcement may play a role as well. As with NCR, positive reinforcement can be effective to increase cooperation and decrease noncompliance that is maintained by escape (Briggs et al., 2019; Carter, 2010; Payne & Dozier, 2013; Slocum & Vollmer, 2015), and this may be due in part to the child’s preference for this type of reinforcement (Gardner et al., 2009; Kodak et al., 2007; Lomas et al., 2010).

Timeout

Timeout is the removal of the child from an enriched environment, usually consisting of preferred items, activities, and attention (i.e., “time in”). Time out should be brief (e.g., 2 min) and may be exclusionary or nonexclusionary (Miltenberger, 2016). Exclusionary timeout involves removal from the time-in room into another room that has no reinforcement or preferred stimulation. Nonexclusionary timeout occurs within the same space as time-in. For example, a teacher may implement nonexclusionary timeout by seating the child in a chair in the corner of the classroom where time-in items, activities, and interactions can be observed but not accessed. A common example is a hockey player being seated in a penalty box during a hockey game. For time out to be effective, the child must prefer the time-in setting, and the function of noncompliance should involve access to the attention, items and activities that are available in that context. For example, Rortvedt and Miltenberger (1994) effectively used timeout for two children whose noncompliance was maintained by attention. Noncompliance is often maintained by escape, at least in part due to the presentation of an instruction as the onset of noncompliance; therefore, caution should be used that timeout does not serve to reinforce noncompliance (e.g., Iwata et al., 1994b). As timeout is considered a more restrictive procedure, we recommend only implementing it when other less restrictive strategies have failed or when the child must be removed from the immediate environment for their own safety or that of others around them. For timeout to be effective, a functional analysis should be conducted, ongoing data collected on cooperation and noncompliance, and the effects should be carefully monitored.

Summary and Practice Recommendations for Active Cooperation

The prior section outlined several antecedent and consequent strategies that may be used in isolation or in combination to promote active cooperation and reduce noncompliance. The nuances of these interventions are complex and rooted in decades of research, which oftentimes requires an experienced Board Certified Behavior Analyst to supervise implementation. That said, some of the antecedent interventions such as effective instruction delivery are clearly described, easy to learn, and practical to implement (e.g., Bellipanni et al., 2013; LaBrot et al., 2020; Morris et al., 2021a). Additionally, learning to focus on, and importantly, provide reinforcers for cooperative responses can be critical to caregivers and teachers achieving success with increasing cooperation. Wood et al. (2018) provided practice guidelines for evidenced-based antecedent strategies, and Donaldson and Austin (2017) outlined several broad strategies, which focus on the antecedent and consequent provision of reinforcers. As described above, both NCR and DRA using positive reinforcers can be effective interventions even when the function of behavior is escape. The crucial aspect for this universal approach is the use of potent reinforcers. If time and resources are limited, allocating effort to identifying preference using relevant assessments may be more important than a functional analysis. Both are indicated when possible, especially when behavior is frequent, persistent, and poses a risk to the child or others.

Passive Cooperation

Passive cooperation involves the omission of behavior during specific conditions. Oftentimes, passive cooperation entails sitting still or tolerating an event by not engaging in a removal behavior (Cook et al., 2015; Rapp, 2012, 2013). In contrast to active cooperation wherein the child is taught to engage in behavior in response to a specific stimulus, the child learns to tolerate an aversive situation in passive cooperation. Children may emit active responses during passive cooperation procedures, but the outcome is the omission of behavior during specific contexts. In many cases, the context is deemed aversive such that the child has a history of engaging in escape or avoidance behaviors. Teaching passive cooperation is critical because the unpleasant events are important for the child's well-being and overall adaptive functioning. An example of passive cooperation is when a child is at the pediatrician's office for a blood draw, and they abstain from engaging in escape behavior. That is, the child sits still during the procedure. In this example, the child does not engage in challenging behaviors such as running away or removing their arm, rather they remain seated and allow a medical professional to insert a needle into their arm. Passive cooperation is critical for teaching children to tolerate events related to their medical well-being (e.g., dental exam), general health (e.g., wearing eyeglasses), safety (e.g., wearing a seatbelt), and daily routines (e.g., riding an escalator). This section will include a discussion of four broad categories of stimulus situations that have been the focus of passive cooperation research. The four categories are feared stimuli, medical and dental procedures, hygiene routines, and prolonged tactile contact.

Categories of Stimuli Associated with Passive Cooperation

Feared Stimuli

The category for feared stimuli refers to specific stimuli or events that elicit autonomic nervous system arousal (a physiological response that prepares the body for a fight or flight response; Miltenberger, 2016), in turn evoking an escape or avoidance response. Fear responses can be conceptualized as behaviors that develop through respondent events (Allen & Kupzyk, 2016; Miltenberger, 2016). For instance, an unconditioned stimulus such as loud barking from a dog may elicit an unconditioned response in the form of autonomic nervous system arousal (e.g., startle response with increased muscle tension and heart rate). The previously neutral stimulus (the dog) which had no history of evoking fear for the person then becomes conditioned through the process of respondent conditioning. This response may serve as an establishing operation for immediate avoidance or escape operant behavior (Miltenberger, 2016), such as crying (to get picked up) or running away from the dog, which are strengthened each time they occur and reinforcement is provided in the form of escape or avoidance.

Within the field of psychiatry, persistent fear responses to specific stimuli which disrupt the daily functioning of a person are known as specific phobias (American Psychiatric Association, 2013). Specific phobias are typically treated with systematic desensitization procedures using visualization, hierarchies, and relaxation training, while the effects are measured using self-report (Miltenberger, 2016). Behavior analysts are likely to approach phobias with in-vivo desensitization, or a similar variation. This approach focuses on operational definitions and objective measurement of the fear response (and or an alternative adaptive response) in the presence of the feared stimulus, rather than using self-report. This approach is especially useful for individuals who struggle in communicating their internal feelings, such as children diagnosed with autism or related disorders (Shabani & Fisher, 2006). Behavior analytic research has demonstrated that children can be taught passive cooperation in the presence of feared stimuli that evoke escape or avoidance which may be out of proportion relative to the actual risk of danger and highly disruptive to important or daily events. The feared stimuli are often found within a community or home setting and may include avoidance of stimuli such as mannequins (e.g., Waranch et al., 1981), escalators (e.g., Runyan et al., 1985), dogs (e.g., Muskett et al., 2020), music (e.g., Buckley & Newchok, 2006), and loud noises (Fodstad et al., 2021).

Medical and Dental Procedures

Medical and dental procedures refer to situations involving routines that are carried out by medical or dental personnel (e.g., nurses, dentists, doctors, assistants, technicians). These routines include blood draws (e.g., Shabani & Fisher, 2006), annual physicals (e.g., Cavalari et al., 2013), and eye exams (Kupzyk et al., 2021). Many children experience anxiety during medical and dental procedures. As with feared stimuli from the previous category, medical and dental procedures acquire aversive features for some individuals due to the pairings of the routines with unpleasant experiences, such as the brief pain felt from a needle prick. A previously neutral syringe becomes conditioned as an aversive stimulus. Other stimuli in the environment may also be conditioned through a process known as higher-order conditioning (Miltenberger, 2016). Subsequently, aversive stimuli are encompassed by anyone wearing a doctor's lab coat or a nurse's uniform, the examination table, the doctor's office, medical instruments, and any number of other stimuli (Allen & Kupzyk, 2016). The resulting operant behaviors such as avoidance, refusal, and aggression are strengthened each time the child escapes or avoids the aversive situation (e.g., the doctor gives up trying to give a needle suggesting they do it next time).

Children with autism have higher rates of noncompliance than their neurotypical peers (Allen & Kupzyk, 2016; Bryce & Jahromi, 2013; Ekas et al., 2017; Jennett & Hagopian, 2008) and may not be getting the preventative or diagnostic care that they need. The inability to passively cooperate during dental and medical procedures is a critical variable that may contribute to poor health outcomes. For example, some children require frequent unpleasant medical interventions, such as insulin injections for type 1 diabetes. For a child with autism and diabetes, administering daily injections may be challenging or impossible because the child may exhibit a variety of intense challenging behaviors (e.g., running away, screaming, biting), reducing the likelihood of consistent lifesaving treatment. Some medical routines are much less invasive than injections, such as reading body temperatures, taking blood pressure, or using an otoscope or stethoscope, but these procedures nonetheless may evoke the same noncompliance in the form of intense challenging behaviors.

Hygiene Routines

Hygiene routines is another category of stimulus conditions that may evoke escape or avoidance behaviors for children with autism. These routines or tasks involve daily living skills that are important to a child's hygiene or personal care such as tolerating teeth brushing, hair cutting (Buckley et al., 2020) or nail clipping (Dowdy et al., 2018), but are reported to be problematic for caregivers of children with autism (Schumacher & Rapp, 2011). Many children with autism refuse to allow their caregivers to provide routine care by engaging in challenging behaviors such as screaming, running away or refusing to sit still. The mere sight of the toothbrush, scissors, nail clipper or related equipment (e.g., hair cutting cape) may lead to high anxiety and intense challenging behaviors. Even though these routines may have aversive features for both the caregiver and the child, they are usually important to a child's social development, health, and well-being.

Prolonged Tactile Contact

Prolonged tactile contact is the fourth category of stimulus situations that require passive cooperation. Prolonged tactile contact refers to a situation whereby a stimulus touches some part of the body for an extended period of time. In other words, a child may be required to wear something that is difficult to tolerate. Wearing simple and common devices may be required to improve a child's daily quality of life by providing access to activities, social interactions, and basic medical assessments. These important activities can be accessed by being able to tolerate devices such as eyeglasses (DeLeon et al., 2008), hearing aids (Nipe et al., 2018; Richling et al., 2011), or a heartrate monitor (Dufour & Lanovaz, 2020). Hence, practitioners should teach passive cooperation to children who engage in challenging behaviors when required to wear medical or health related devices.

More recently, a unique challenge was presented for all caregivers of young children, and especially those of children with autism. Mask wearing became an essential mitigation strategy for the COVID-19 pandemic in 2020 (Chu et al., 2020). Children with autism may present more risk for developing severe illness due to their compromised immune systems (de Sousa Lima et al., 2020). After mandated school shutdowns in the spring of 2020, some parts of the United States began easing restrictions and reopening schools, with mask mandates for students. For caregivers with children with autism, mask wearing posed a major challenge since many children do not tolerate some tactile stimuli (e.g., Cook et al., 2015; Nipe et al., 2018; Sivaraman et al., 2021).

Antecedent Interventions

Exposure

Practitioners may manipulate antecedents in several ways such as exposure without and with fading. Exposure without fading consists of presenting the whole stimulus during a single training session. For example, Dowdy et al. (2018) used differential reinforcement without escape extinction to reinforce nail cutting with a child with autism. The researchers presented the nail clipper and reinforced a complete nail cut and any escape responses. Moreover, the session ended when the participant tolerated all nail cutting or when 5 min had elapsed. Implementing the procedure without incorporating fading was appropriate for this particular target skill because the task did not involve many steps, and it is not possible to repeatedly clip nails without extensive periods between sessions for nails to regrow. By contrast, exposure with fading gradually manipulates the duration, distance, amount, or context of presentation of the aversive stimulus. For example, Sivaraman et al. (2021) taught six children with autism to tolerate wearing a face-mask for brief periods of time. The researchers provided continuous access to moderately preferred items while increasing the duration that the children kept the mask on for some sessions. At the end of the study, all children wore the face mask for the targeted duration of 10 min without challenging behaviors. Other studies gradually and systematically increased the time spent experiencing the aversive stimuli (Bishop et al., 2013; Cook et al., 2015; Cox et al., 2017; Dufour & Lanovaz, 2020; Richling et al., 2011).

Ricciardi et al. (2006) evaluated a procedure which faded the distance to increase passive cooperation for a child who avoided animatronic objects in public places. The researchers systematically decreased the proximity between the child and the object while providing continuous access to preferred items. The results showed that the participant remained at the specified distances without engaging in challenging behavior. Rapp et al. (2005) faded the amount of aversive stimulus (pool depth) using a procedure for pool avoidance. The researchers set up a situation in which an adolescent with autism received reinforcement for approaching the pool. Although active responses were initially reinforced, the researchers measured the omission of challenging behavior at each depth once the participant entered the pool. The criterion was gradually changed so that the participant needed to tolerate deeper parts. Carter et al. (2019) faded the context of an aversive situation when increasing cooperation with dental routines for two males with autism. The aversive features of the context involved a dental chair, a bib, an electric toothbrush, and a dental utensil. This procedure involved both aspects of passive cooperation (e.g., allowing teeth to be counted) and active cooperation (e.g., opening mouth).

Noncontingent Reinforcement

Several researchers have used NCR as a strategy to promote passive cooperation (e.g., DeLeon et al., 2008; Maguire et al., 1996; Nipe et al., 2018). For example, Richling et al. (2011) taught two children to tolerate prescription prostheses by providing NCR and access to escape. The researchers provided noncontingent continuous access to preferred items and music and delivered attention on a fixed time of 5 s. Additionally, the child had access to escape for 15 s contingent on removing the prostheses. Thereafter, the researchers placed the prosthesis back on the participant. NCR with the absence of escape extinction was effective for both participants to increase their passive cooperation with wearing prostheses. Given the side effects that may be induced by escape extinction, practitioners should consider options which allow for the exclusion of escape extinction while incorporating antecedent- or reinforcement-based strategies to increase passive cooperation with aversive stimuli.

Consequent Interventions

Differential Reinforcement of Other Behavior

When implementing differential reinforcement of other behavior (DRO), the caregiver or teacher provides a reinforcer in the absence of behavior after a pre-determined interval of time has elapsed (Miltenberger, 2016). In the case of passive cooperation, reinforcement is provided for the omission of challenging behavior that may interfere with cooperation during specific conditions (i.e., sitting still when getting blood drawn). Several studies support the efficacy of DRO for increasing passive cooperation (Dowdy et al., 2018; Dufour & Lanovaz, 2020; Reimers et al., 1988; Ricciardi et al., 2006). For example, Dufour and Lanovaz (2020) evaluated DRO for increasing compliance with wearing a heartrate monitor for two children with autism. The researchers delivered praise and edibles contingent on not touching the heartrate monitor on their chest for the specific interval. With every successful interval, the researchers increased the time criterion. Both participants met the criterion of 90 s with the device in contact with their chest despite participants having access to escape contingent on attempting to remove the device.

A variation of DRO used in the passive cooperation literature is differential negative reinforcement of other behavior (DNRO; Buckley & Newchok, 2006; Cook et al., 2015). Similar to DRO, this procedure involves reinforcing the omission of behavior, but in this case, the reinforcer is escape from an aversive situation. For example, Cook et al. (2015) demonstrated the effectiveness of DNRO as a procedure to increase cooperation with a child with autism for wearing a medical bracelet. The researchers systematically increased the interval when the child cooperated by keeping the bracelet on his wrist. At the end of each successful interval, the experimenter permitted the child to remove the medical bracelet for a pre-determined duration. Thus, cooperative behaviors resulted in escape (i.e., removal of the bracelet). Their results showed that DNRO was effective for increasing cooperation with wearing a medical bracelet for up to 7 h at the clinic, and the authors reported that he wore the bracelet for 24-h days for several years thereafter.

Differential Reinforcement of Alternative Behavior

As indicated earlier, DRA involves reinforcing a desirable behavior while minimizing reinforcement for an undesirable behavior (Vollmer et al., 2020). Several studies have used DRA as a procedure to increase passive cooperation (Birkan et al., 2011; Carter et al., 2019; Cavalari et al., 2013; Conyers et al., 2004; Ellis et al., 2006). Passive cooperation is, by definition, the omission of challenging behavior under specific stimulus conditions, but those stimulus conditions may involve a more complex context requiring specific active responses to facilitate the passive response. For example, passive cooperation at a dental visit requires that a child allows a dental hygienist to use a scaler, an aspirator, or other tools in their mouth. However, toleration of the dental cleaning procedure also requires the child to enter the room, sit in the chair, and open their mouth. Although the desired outcome is passive cooperation of a dental cleaning, the entire context relevant to this response involves some active responses. Said differently, passive cooperation may involve other behaviors beside sitting still, such as the typical responses involved in the routine tasks that passive cooperation is required.

In another example, a person who fears riding on escalators may be unable to engage in the typical responses of stepping on an escalator to get to the second floor of a mall where their favorite store is located. Their routine functioning at the mall is impaired relative to the ease of movement for other shoppers. Furthermore, the sight of the escalator may cause anxiety and intense behavior to avoid an area of the mall, and attempting to go to the mall at all may become debilitating. If the child (or their caregiver) deems learning to ride the escalator to be an important goal for intervention, the active responses of stepping on and off the moving escalator will be required to tolerate passively standing on the escalator as it carries the person to the next level (e.g., Runyan et al., 1985). Similarly, Cromartie et al. (2014) evaluated an intervention for the avoidance of blood draws using DRA. In this case, active responses such as walking to the office and extending an arm, along with the passive responses of waiting in the waiting room, accepting cotton to be swabbed across the arm, and allowing a tourniquet to be applied were criterion steps to ultimately facilitate passive cooperation when blood was being drawn. The child received reinforcement contingent on these approach steps within the DRA arrangement to successfully teach tolerating blood draws required for monitoring the safety and effectiveness of her medical intervention.

Response Blocking and Response Cost

To decrease challenging behaviors that interfere with cooperative responses, some researchers have utilized response blocking and response cost. DeLeon et al. (2008) evaluated a treatment package that included NCR, response blocking, and response cost that to teach four individuals to wear their eyeglasses. The response blocking procedure involved physically blocking attempts to remove the eyeglasses and for the first 5 s of the session to initially facilitate keeping the glasses on. Thereafter, the participant was permitted to remove their eyeglasses. Another component of the intervention included a response cost procedure involving the withdrawal of preferred items contingent on the participant removing the eyeglasses. The treatment package was successful for three participants, and when the researchers conducted a component analysis for two of those participants, they found that response blocking was an effective component for promoting passive cooperation with wearing eyeglasses. By contrast, NCR alone was sufficient for teaching the participant to keep their eyeglasses on for the fourth participant. Other studies have also incorporated response blocking (sometimes referred to as manual guidance) with their intervention and reported similar findings (Birkan et al., 2011; Cook et al., 2015; Rapp et al., 2005). In another study on the treatment of challenging behaviors associated with wearing eyeglasses and hearing aids, Nipe et al. (2018) conducted a component analysis and found that NCR was effective for increasing passive cooperation with wearing prostheses, but the effects were enhanced when response blocking and response cost procedures were added.

Escape Extinction

Challenging behaviors that occur within contexts associated with passive cooperation have a presumed negative reinforcement function insofar as the child engages in behaviors that result in avoiding or escaping the aversive situations. A common treatment for escape-maintained challenging behavior is escape extinction. Some researchers have implemented escape extinction as part of their intervention for decreasing challenging behaviors that interfere with passive cooperation (Birkan et al., 2011; Rapp et al., 2005). In this case, we are defining extinction as not allowing reinforcement for the behavior (disruptive behaviors do not result in escape), but other behavioral mechanisms may influence behavior. In an example of escape extinction used to decrease challenging behaviors during swimming pool avoidance in an adolescent with autism, Rapp et al. (2005) targeted escape behaviors by prompting the participant to sit in a chair that the researchers moved closer to the pool. This component of the intervention prevented the participant from escaping the aversive stimulus, which resulted in the reduction of challenging behavior and the toleration of a swimming pool.

Escape extinction has been shown to produce decreases in challenging behavior. The main issue with escape extinction is that it may result in undesirable side effects such as aggression and emotional responding, making this strategy not a viable option for many caregivers and teachers (see Lerman & Iwata, 1995). Other researchers have evaluated treatments to increase passive cooperation with aversive tasks and decrease disruptive behaviors in the absence of escape extinction (Bishop et al., 2013; Dowdy et al., 2018; Dufour & Lanovaz, 2020; Richling et al., 2011; Schumacher & Rapp, 2011; Shabani & Fisher, 2006). Instead, the researchers provided escape contingent on challenging behavior. The findings from these studies showed that, even though challenging behavior continued to produce escape, the antecedent procedures or the reinforcement contingencies for cooperative behaviors resulted in desirable outcomes. Nonetheless, extinction is indicated when practical to achieve best outcomes (e.g., Vollmer et al., 2020). To mitigate the potential side effects of using escape extinction, practitioners may combine it with noncontingent or contingent reinforcement to increase passive cooperation.

Summary and Practice Recommendations for Passive Cooperation

The previous section described an area in the noncompliance literature that, to our knowledge, has not yet been reviewed: passive cooperation to tolerate aversive but important stimuli (or events) in a child's life. These stimuli can be a challenge for typically-developing children, and may be exponentially more difficult for children diagnosed with autism. Despite the anxiety-inducing nature of these stimuli and the intense behaviors they may evoke, toleration is required for an individual's medical well-being, general health, safety, and daily functioning. Several least-restrictive intervention options may support behavior analysts in reducing challenging behavior related to passive cooperation such as exposure, NCR, DRO, and DRA. Due to the aversive aspects involved in problems requiring interventions to teach passive cooperation, practitioners should limit their use of more restrictive strategies (e.g., escape extinction, response cost and blocking) to situations when less restrictive alternatives have failed. Additionally, a behavior analyst should be involved in designing these interventions due to ethical and safety concerns. Oftentimes, the intervention will also require the seamless collaboration of multiple professionals (e.g., doctors, dentists).

Conclusion

In sum, practitioners have multiple options when intervening to increase active and passive cooperation in children with autism. The first step involves conducting a functional assessment to identify the variables that maintain noncompliance and engagement in related challenging behavior. In the most likely event that the intervention includes a reinforcer or preferred stimulus, conducting a preference assessment also appears essential to increase the effectiveness. For clarity, we presented each intervention individually as part of the current chapter. In practice, we strongly recommend combining multiple interventions together to increase the probability of producing the targeted behavior changes. As evidenced by the exemplars discussed, most researchers combine several components when studying interventions for both active and passive compliance. As with any behavioral intervention, the main keys to success involve thorough assessment, careful treatment selection, and rigorous monitoring of the target behavior. Following this process will ensure that children with autism receive the best treatment to increase cooperation and, in turn, improve their health and well-being.

References

Achenbach, T. M., & Edelbrock, C. S. (1981). Behavioral problems and competencies reported by parents of normal and disturbed children aged four through sixteen. *Monographs of the Society for Research in Child Development, 46*(1), 1–82. https://doi.org/10.2307/1165983

Allen, K. D., & Kupzyk, S. (2016). Compliance with medical routines. In J. K. Luiselli (Ed.), *Behavioral health promotion and intervention in intellectual and developmental disabilities* (pp. 21–42). Springer. https://doi.org/10.1007/978-3-319-27297-9_2

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Anderson, C. M., & Long, E. S. (2002). Use of a structured descriptive assessment methodology to identify variables affecting problem behavior. *Journal of Applied Behavior Analysis, 35*(2), 137–154. https://doi.org/10.1901/jaba.2002.35-137

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The rights of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Applied Behavior Analysis, 23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Beavers, G. A., Iwata, B. A., & Lerman, D. C. (2013). Thirty years of research on the functional analysis of problem behavior. *Journal of Applied Behavior Analysis, 46*(1), 1–21. https://doi.org/10.1002/jaba.30

Behavior Analyst Certification Board. (2014). *Professional and ethical compliance code for behavior analysts.* https://www.bacb.com/wpcontent/uploads/2020/05/BACB-Compliance-Code-english_190318.pdf

Belfiore, P. J., Basile, S. P., & Lee, D. L. (2008). Using a high probability command sequence to increase classroom compliance: The role of behavioral momentum. *Journal of Behavioral Education, 17*(2), 160–171. https://doi.org/10.1007/s10864-007-9054-x

Bellipanni, K. D., Tingstrom, D. H., Olmi, D. J., & Roberts, D. S. (2013). The sequential introduction of positive antecedent and consequent components in a compliance training package with elementary students. *Behavior Modification, 37*(6), 768–789. https://doi.org/10.1177/0145445513501959

Berg, W. K., Wacker, D. P., Cigrand, K., Merkle, S., Wade, J., Henry, K., & Wang, Y.-C. (2007). Comparing functional analysis and paired-choice assessment results in classroom settings. *Journal of Applied Behavior Analysis, 40*(3), 545–552. https://doi.org/10.1901/jaba.2007.40-545

Birkan, B., Krantz, P. J., & McClannahan, L. E. (2011). Teaching children with autism spectrum disorders to cooperate with injections. *Research in Autism Spectrum Disorders, 5*(2), 941–948. https://doi.org/10.1016/j.rasd.2010.11.004

Bishop, M. R., Kenzer, A. L., Coffman, C. M., Tarbox, C. M., Tarbox, J., & Lanagan, T. M. (2013). Using stimulus fading without escape extinction to increase compliance with toothbrushing in children with autism. *Research in Autism Spectrum Disorders, 7*(6), 680–686. https://doi.org/10.1016/j.rasd.2013.02.004

Bouxsein, K. J., Tiger, J. H., & Fisher, W. W. (2008). A comparison of general and specific instructions to promote task engagement and completion by a young man with Asperger syndrome. *Journal of Applied Behavior Analysis, 41*(1), 113–116. https://doi.org/10.1901/jaba.2008.41-113

Briggs, A. M., Dozier, C. L., Lessor, A. N., Kamana, B. U., & Jess, R. L. (2019). Further investigation of differential reinforcement of alternative behavior without extinction for escape-maintained destructive behavior. *Journal of Applied Behavior Analysis, 52*(4), 956–973. https://doi.org/10.1002/jaba.648

Brosh, C. R., Fisher, L. B., Wood, C. L., & Test, D. W. (2018). High-probability request sequence: An evidence-based practice for individuals with autism spectrum disorder. *Education and Training in Autism and Developmental Disabilities, 53*(3), 276–286.

Brown, K. R., Greer, B. D., Craig, A. R., Sullivan, W. E., Fisher, W. W., & Roane, H. S. (2020). Resurgence following differential reinforcement of alternative behavior implemented with and without extinction. *Journal of the Experimental Analysis of Behavior, 113*(2), 449–467. https://doi.org/10.1002/jeab.588

Brunton, S. (2017). I have never liked the term “compliance”. *Clinical Diabetes: A Publication of the American Diabetes Association, 35*(2), 76–77. https://doi.org/10.2337/cd17-0010

Bryce, C. I., & Jahromi, L. B. (2013). Brief report: Compliance and noncompliance to parental control strategies in children with high-functioning autism and their typical peers. *Journal of Autism and Developmental Disorders, 43*(1), 236–243. https://doi.org/10.1007/s10803-012-1564-2

Buckley, J., Luiselli, J. K., Harper, J. M., & Shlesinger, A. (2020). Teaching students with autism spectrum disorder to tolerate haircutting. *Journal of Applied Behavior Analysis, 53*(4), 2081–2089. https://doi.org/10.1002/jaba.713

Buckley, S. D., & Newchok, D. K. (2006). Analysis and treatment of problem behavior evoked by music. *Journal of Applied Behavior Analysis, 39*(1), 141–144. https://doi.org/10.1901/jaba.2006.120-04

Bullock, C., & Normand, M. P. (2006). The effects of a high-probability instruction sequence and response-independent reinforcer delivery on child compliance. *Journal of Applied Behavior Analysis, 39*(4), 495–499. https://doi.org/10.1901/jaba.2006.115-05

Call, N. A., Scheithauer, M. C., & Mevers, J. L. (2017). Functional behavioral assessments. In J. K. Luiselli (Ed.), *Applied behavior analysis advanced guidebook* (pp. 41–71). Academic Press. https://doi.org/10.1016/B978-0-12-811122-2.00003-6

Call, N. A., Trosclair-Lasserre, N. M., Findley, A. J., Reavis, A. R., & Shillingsburg, M. A. (2012). Correspondence between single versus daily preference assessment outcomes and reinforcer efficacy under Progressive-Ratio Schedules. *Journal of Applied Behavior Analysis, 45*(4), 763–777. https://doi.org/10.1901/jaba.2012.45-763

Carr, J. E., Nicolson, A. C., & Higbee, T. S. (2000). Evaluation of a brief multiple-stimulus preference assessment in a naturalistic context. *Journal of Applied Behavior Analysis, 33*(3), 353–357. https://doi.org/10.1901/jaba.2000.33-353

Carr, J. E., Severtson, J. M., & Lepper, T. L. (2009). Noncontingent reinforcement is an empirically supported treatment for problem behavior exhibited by individuals with developmental disabilities. *Research in Developmental Disabilities, 30*(1), 44–57. https://doi.org/10.1016/j.ridd.2008.03.002

Carter, L., Harper, J. M., & Luiselli, J. K. (2019). Dental desensitization for students with autism spectrum disorder through graduated exposure, reinforcement, and reinforcement-fading. *Journal of Developmental and Physical Disabilities, 31*(2), 161–170. https://doi.org/10.1007/s10882-018-9635-8

Carter, S. L. (2010). A comparison of various forms of reinforcement with and without extinction as treatment for escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 43*(3), 543–546. https://doi.org/10.1901/jaba.2010.43-543

Cavalari, R. N. S., DuBard, M., Luiselli, J. K., & Birtwell, K. (2013). Teaching an adolescent with autism and intellectual disability to tolerate routine medical examination: Effects of a behavioral compliance training package. *Clinical Practice in Pediatric Psychology, 1*(2), 121–128. https://doi.org/10.1037/cpp0000013

Chu, D. K., Akl, E. A., Duda, S., Solo, K., Yaacoub, S., Schünemann, H. J., Chu, D. K., Akl, E. A., El-harakeh, A., Bognanni, A., Lotfi, T., Loeb, M., Hajizadeh, A., Bak, A., Izcovich, A., Cuello-Garcia, C. A., Chen, C., Harris, D. J., Borowiack, E., et al. (2020). Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: A systematic review and meta-analysis. *The Lancet, 395*(10242), 1973–1987. https://doi.org/10.1016/S0140-6736(20)31142-9

Coleman, C. L., & Holmes, P. A. (1998). The use of noncontingent escape to reduce disruptive behaviors in children with speech delays. *Journal of Applied Behavior Analysis, 31*(4), 687–690. https://doi.org/10.1901/jaba.1998.31-687

Conyers, C., Miltenberger, R. G., Peterson, B., Gubin, A., Jurgens, M., Selders, A., Dickinson, J., & Barenz, R. (2004). An evaluation of in vivo desensitization and video modeling to increase compliance with dental procedures in persons with mental retardation. *Journal of Applied Behavior Analysis, 37*(2), 233–238. https://doi.org/10.1901/jaba.2004.37-233

Cook, B., Duris, J., Martin, T. L., & McCombe, L. (2019). Behavioural strategies to address noncompliance. In J. L. Matson (Ed.), *Handbook of intellectual disabilities: Integrating theory, research, and practice* (pp. 547–564). Springer International Publishing. https://doi.org/10.1007/978-3-030-20843-1_30

Cook, J. L., Rapp, J. T., & Schulze, K. A. (2015). Differential negative reinforcement of other behavior to increase wearing of a medical bracelet. *Journal of Applied Behavior Analysis, 48*(4), 901–906. https://doi.org/10.1002/jaba.228

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis* (3rd ed.). Pearson Education.

Cote, C. A., Thompson, R. H., & McKerchar, P. M. (2005). The effects of antecedent interventions and extinction on toddlers' compliance during transitions. *Journal of Applied Behavior Analysis, 38*(2), 235–238. https://doi.org/10.1901/jaba.2005.143-04

Cox, A. D., Virues-Ortega, J., Julio, F., & Martin, T. L. (2017). Establishing motion control in children with autism and intellectual disability: Applications for anatomical and functional MRI. *Journal of Applied Behavior Analysis, 50*(1), 8–26. https://doi.org/10.1002/jaba.351

Cromartie, R. S., Flood, W. A., & Luiselli, J. K. (2014). Graduated exposure and compliance training intervention for blood draw avoidance and refusal in a woman with intellectual disability and schizoaffective disorder. *Journal of Mental Health Research in Intellectual Disabilities, 7*(2), 95–103. https://doi.org/10.1080/19315864.2012.750407

Crowther, J. H., Bond, L. A., & Rolf, J. E. (1981). The incidence, prevalence, and severity of behavior disorders among preschool-aged children in day care. *Journal of Abnormal Child Psychology, 9*(1), 23–42. https://doi.org/10.1007/BF00917855

de Sousa Lima, M. E., Barros, L. C. M., & Aragão, G. F. (2020). Could autism spectrum disorders be a risk factor for COVID-19?. *Medical Hypotheses, 144*, 109899. https://doi.org/10.1016/j.mehy.2020.109899

DeLeon, I. G., Chase, J. A., Frank-Crawford, M. A., Carreau-Webster, A. B., Triggs, M. M., Bullock, C. E., & Jennett, H. K. (2014). Distributed and accumulated reinforcement arrangements: Evaluations of efficacy and preference. *Journal of Applied Behavior Analysis, 47*(2), 293–313. https://doi.org/10.1002/jaba.116

DeLeon, I. G., Hagopian, L. P., Rodriguez-Catter, V., Bowman, L. G., Long, E. S., & Boelter, E. W. (2008). Increasing wearing of prescription glasses in individuals with mental retardation. *Journal of Applied Behavior Analysis, 41*(1), 137–142. https://doi.org/10.1901/jaba.2008.41-137

Donaldson, J. M., & Austin, J. L. (2017). Environmental and social factors in preventing, assessing, and treating problem behavior in young children. *Policy Insights From the Behavioral and Brain Sciences, 4*(1), 9–16. https://doi.org/10.1177/2372732216683964

Donaldson, J. M., Trahan, M. A., & Kahng, S. (2014). An evaluation of procedures to increase cooperation related to hoarding in an older adult with dementia. *Journal of Applied Behavior Analysis, 47*(2), 410–414. https://doi.org/10.1002/jaba.112

Dowdy, A., Tincani, M., Nipe, T., & Weiss, M. J. (2018). Effects of reinforcement without extinction on increasing compliance with nail cutting: A systematic replication. *Journal of Applied Behavior Analysis, 51*(4), 924–930. https://doi.org/10.1002/jaba.484

Ducharme, J. M., & Worling, D. E. (1994). Behavioral momentum and stimulus fading in the acquisition and maintenance of child compliance in the home. *Journal of Applied Behavior Analysis, 27*(4), 639–647. https://doi.org/10.1901/jaba.1994.27-639

Dufour, M.-M., & Lanovaz, M. J. (2020). Increasing compliance with wearing a medical device in children with autism. *Journal of Applied Behavior Analysis, 53*(2), 1089–1096. https://doi.org/10.1002/jaba.628

Durand, V. M., & Crimmins, D. B. (1988). Identifying the variables maintaining self-injurious behavior. *Journal of Autism and Developmental Disorders, 18*(1), 99–117.

Ekas, N. V., McDonald, N. M., Pruitt, M. M., & Messinger, D. S. (2017). Brief report: The development of compliance in toddlers at-risk for autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*(4), 1239–1248. https://doi.org/10.1007/s10803-016-2984-1

Ellis, E. M., Ala'i-Rosales, S. S., Glenn, S. S., Rosales-Ruiz, J., & Greenspoon, J. (2006). The effects of graduated exposure, modeling, and contingent social attention on tolerance to skin care products with two children with autism. *Research in Developmental Disabilities, 27*(6), 585–598. https://doi.org/10.1016/j.ridd.2005.05.009

Ertel, H., Wilder, D. A., Hodges, A., & Hurtado, L. (2019). The effect of various high-probability to low-probability instruction ratios during the use of the high-probability instructional sequence. *Behavior Modification, 43*(5), 639–655. https://doi.org/10.1177/0145445518782396

Fagot, B. I., & Leve, L. D. (1998). Teacher ratings of externalizing behavior at school entry for boys and girls: Similar early predictors and different correlates. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 39*(4), 555–566. https://doi.org/10.1017/S002196309800225X

Favell, J. E., Favell, J. E., Riddle, J. I., & Risley, T. R. (1984). Promoting change in mental retardation facilities. In W. P. Christian, G. T. Hannah, & T. J. Glahn (Eds.), *Programming effective human services: Strategies for institutional change and client transition* (pp. 15–37). Springer. https://doi.org/10.1007/978-1-4613-2707-3_2

Feldman, R. (2007). Mother-infant synchrony and the development of moral orientation in childhood and adolescence: Direct and indirect mechanisms of developmental continuity. *American Journal of Orthopsychiatry, 77*(4), 582–597. https://doi.org/10.1037/0002-9432.77.4.582

Finkel, A. S., Derby, K. M., Weber, K. P., & McLaughlin, T. F. (2003). Use of choice to identify behavioral function following an inconclusive brief functional analysis. *Journal of Positive Behavior Interventions, 5*(2), 112–121. https://doi.org/10.1177/10983007030050020601

Fischetti, A. T., Wilder, D. A., Myers, K., Leon-Enriquez, Y., Sinn, S., & Rodriguez, R. (2012). An evaluation of evidence-based interventions to increase compliance among children with autism. *Journal of Applied Behavior Analysis, 45*(4), 859–863. https://doi.org/10.1901/jaba.2012.45-859

Fodstad, J. C., Kerswill, S. A., Kirsch, A. C., Lagges, A., & Schmidt, J. (2021). Assessment and treatment of noise hypersensitivity in a teenager with autism spectrum disorder: A case study. *Journal of Autism and Developmental Disorders, 51*(6), 1811–1822. https://doi.org/10.1007/s10803-020-04650-w

Freeman, K. A., Anderson, C. M., & Scotti, J. R. (2000). A structured descriptive methodology: Increasing agreement between descriptive and experimental analyses. *Education and Training in Mental Retardation and Developmental Disabilities, 35*(1), 55–66.

Fulton, C. J., Tiger, J. H., Meitzen, H. M., & Effertz, H. M. (2020). A comparison of accumulated and distributed reinforcement periods with children exhibiting escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 53*(2), 782–795. https://doi.org/10.1002/jaba.622

Gardner, A. W., Wacker, D. P., & Boelter, E. W. (2009). An evaluation of the interaction between quality of attention and negative reinforcement with children who display escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 42*(2), 343–348. https://doi.org/10.1901/jaba.2009.42-343

Hamlet, C. C., Axelrod, S., & Kuerschner, S. (1984). Eye contact as an antecedent to compliant behavior. *Journal of Applied Behavior Analysis, 17*(4), 553–557. https://doi.org/10.1901/jaba.1984.17-553

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis, 47*(1), 16–36. https://doi.org/10.1002/jaba.106

Hodges, A. C., Shuler, A., Wilder, D. A., & Ertel, H. (2021). The effects of stimulus magnitude and duration during pretrial delivery of preferred items to increase compliance. *Journal of Applied Behavior Analysis, 54*(2), 713–724. https://doi.org/10.1002/jaba.798

Houlihan, D., & Jones, R. N. (1990). Exploring the reinforcement of compliance with "do" and "don't" requests and the side effects: A partial replication and extension. *Psychological Reports, 67*(2), 439–448. https://doi.org/10.2466/pr0.1990.67.2.439

Ingvarsson, E. T., Kahng, S., & Hausman, N. L. (2008). Some effects of noncontingent positive reinforcement on multiply controlled problem behavior and compliance in a demand context. *Journal of Applied Behavior Analysis, 41*(3), 435–440. https://doi.org/10.1901/jaba.2008.41-435

Issarraras, A., & Matson, J. L. (2020). Treating noncompliance in persons with dual diagnosis. In J. L. Matson (Ed.), *Handbook of dual diagnosis: Assessment and treatment in persons with intellectual disorders* (pp. 647–657). Springer International Publishing. https://doi.org/10.1007/978-3-030-46835-4_37

Iwata, B. A., DeLeon, I. G., & Roscoe, E. M. (2013). Reliability and validity of the functional analysis screening tool. *Journal of Applied Behavior Analysis, 46*(1), 271–284. https://doi.org/10.1002/jaba.31

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994a). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*(2), 197–209. https://doi.org/10.1901/jaba.1994.27-197

Iwata, B. A., & Dozier, C. L. (2008). Clinical application of functional analysis methodology. *Behavior Analysis in Practice, 1*(1), 3–9. https://doi.org/10.1007/BF03391714

Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994b). What makes extinction work: An analysis of procedural form and function. *Journal of Applied Behavior Analysis, 27*(1), 131–144. https://doi.org/10.1901/jaba.1994.27-131

Jennett, H. K., & Hagopian, L. P. (2008). Identifying empirically supported treatments for phobic avoidance in individuals with intellectual disabilities. *Behavior Therapy, 39*(2), 151–161. https://doi.org/10.1016/j.beth.2007.06.003

Kalb, L. M., & Loeber, R. (2003). Child disobedience and noncompliance: A review. *Pediatrics, 111*(3), 641–652. https://doi.org/10.1542/peds.111.3.641

Keenan, K., Shaw, D., Delliquadri, E., Giovannelli, J., & Walsh, B. (1998). Evidence for the continuity of early problem behaviors: Application of a developmental model. *Journal of Abnormal Child Psychology, 26*(6), 441–452. https://doi.org/10.1023/A:1022647717926

King, H., Houlihan, D., Radley, K., & Lai, D. (2021). The evolution of high probability command sequences: Theoretical and procedural concerns. *European Journal of Behavior Analysis, 22*(1), 59–73. https://doi.org/10.1080/15021149.2020.1758989

Kleinsinger, F. (2003). Understanding noncompliant behavior: Definitions and causes. *The Permanente Journal, 7*(4), 18–21.

Kodak, T., Lerman, D. C., Volkert, V. M., & Trosclair, N. (2007). Further examination of factors that influence preference for positive versus negative reinforcement. *Journal of Applied Behavior Analysis, 40*(1), 25–44. https://doi.org/10.1901/jaba.2007.151-05

Kodak, T., Miltenberger, R. G., & Romaniuk, C. (2003a). The effects of differential negative reinforcement of other behavior and noncontingent escape on compliance. *Journal of Applied Behavior Analysis, 36*(3), 379–382. https://doi.org/10.1901/jaba.2003.36-379

Kodak, T., Miltenberger, R. G., & Romaniuk, C. (2003b). A comparison of differential reinforcement and noncontingent reinforcement for the treatment of a child's multiply controlled problem behavior. *Behavioral Interventions, 18*(4), 267–278. https://doi.org/10.1002/bin.143

Kupzyk, S., & Allen, K. D. (2019). A review of strategies to increase comfort and compliance with medical/dental routines in persons with intellectual and developmental disabilities. *Journal of Developmental and Physical Disabilities, 31*(2), 231–249. https://doi.org/10.1007/s10882-018-09656-y

Kupzyk, S., Zawoyski, A. M., & Cox, J. (2021). Treatment of noncompliance with eye examination procedures in pediatric primary care. *Behavior Analysis: Research and Practice, 21*(1), 90–101. https://doi.org/10.1037/bar0000205

LaBrot, Z. C., Kupzyk, S., Strong-Bak, W., Pasqua, J. L., & Mahon, J. (2020). Examination of group-based behavioral skills training for parents of children with intellectual and neurodevelopmental disorders. *Child & Family Behavior Therapy, 42*(2), 98–124. https://doi.org/10.1080/07317107.2020.1738715

Lalli, J. S., Vollmer, T. R., Progar, P. R., Wright, C., Borrero, J., Daniel, D., Barthold, C. H., Tocco, K., & May, W. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis, 32*(3), 285–296. https://doi.org/10.1901/jaba.1999.32-285

Lambert, J. M., Clohisy, A. M., Barrows, S. B., & Houchins-Juarez, N. J. (2017). Compound-schedules approaches to noncompliance: Teaching children when to ask and when to work. *Journal of Behavioral Education, 26*(2), 201–220.

Lanovaz, M. J., Argumedes, M., Roy, D., Duquette, J. R., & Watkins, N. (2013). Using ABC narrative recording to identify the function of problem behavior: A pilot study. *Research in Developmental Disabilities, 34*(9), 2734–2742. https://doi.org/10.1016/j.ridd.2013.05.038

Laraway, S., Snycerski, S., Michael, J., & Poling, A. (2003). Motivating operations and terms to describe them: Some further refinements. *Journal of Applied Behavior Analysis, 36*(3), 407–414. https://doi.org/10.1901/jaba.2003.36-407

Leaf, J. B., Cihon, J. H., Leaf, R., McEachin, J., Liu, N., Russell, N., Unumb, L., Shapiro, S., & Khosrowshahi, D. (2021). Concerns about ABA-based intervention: An evaluation and recommendations. *Journal of Autism and Developmental Disorders.* https://doi.org/10.1007/s10803-021-05137-y

Lerman, D. C., & Iwata, B. A. (1995). Prevalence of the extinction burst and its attenuation during treatment. *Journal of Applied Behavior Analysis, 28*(1), 93–94. https://doi.org/10.1901/jaba.1995.28-93

Lipschultz, J., & Wilder, D. A. (2017a). Recent research on the high-probability instructional sequence: A brief review. *Journal of Applied Behavior Analysis, 50*(2), 424–428. https://doi.org/10.1002/jaba.378

Lipschultz, J., Wilder, D. A., & Enderli, A. (2017). Effects of response independent delivery of preferred items and the high-probability instructional sequence on compliance. *Behavioral Interventions, 32*(2), 144–151. https://doi.org/10.1002/bin.1474

Lipschultz, J. L., & Wilder, D. A. (2017b). Behavioral assessment and treatment of noncompliance: A review of the literature. *Education and Treatment of Children, 40*(2), 263–298. https://doi.org/10.1353/etc.2017.0012

Lloyd, B. P., Weaver, E. S., & Staubitz, J. L. (2017). Embedding a functional analysis of compliance in small group instruction. *Behavioral Interventions, 32*(4), 427–433. https://doi.org/10.1002/bin.1494

Lomas, J. E., Fisher, W. W., & Kelley, M. E. (2010). The effects of variable-time delivery of food items and praise on problem behavior reinforced by escape. *Journal of Applied Behavior Analysis, 43*(3), 425–435. https://doi.org/10.1901/jaba.2010.43-425

Losinski, M., Sanders, S., Katsiyannis, A., & Wiseman, N. (2017). A meta-analysis of interventions to improve the compliance of students with disabilities. *Education and Treatment of Children, 40*(4), 435–463. https://doi.org/10.1353/etc.2017.0020

Mace, F. C., Hock, M. L., Lalli, J. S., West, B. J., Belfiore, P., Pinter, E., & Brown, D. K. (1988). Behavioral momentum in the treatment of noncompliance. *Journal of Applied Behavior Analysis, 21*(2), 123–141. https://doi.org/10.1901/jaba.1988.21-123

Maguire, K. B., Lange, B., Scherling, M., & Grow, R. (1996). The use of rehearsal and positive reinforcement in the dental treatment of uncooperative patients with mental retardation. *Journal of Developmental and Physical Disabilities, 8*(2), 167–177. https://doi.org/10.1007/BF02578447

Majdalany, L. M., Wilder, D. A., Allgood, J., & Sturkie, L. (2017). Evaluation of a preliminary method to examine antecedent and consequent contributions to noncompliance. *Journal of Applied Behavior Analysis, 50*(1), 146–158. https://doi.org/10.1002/jaba.353

Mandal, R. L., Olmi, D. J., Edwards, R. P., Tingstrom, D. H., & Benoit, D. A. (2000). Effective instruction delivery and time-in: Positive procedures for achieving child compliance. *Child & Family Behavior Therapy, 22*(4), 1–12. https://doi.org/10.1300/J019v22n04_01

Matson, J. L., Tureck, K., & Rieske, R. (2012). The questions about behavioral function (QABF): Current status as a method of functional assessment. *Research in Developmental Disabilities, 33*(2), 630–634. https://doi.org/10.1016/j.ridd.2011.11.006

McKerchar, P. M., & Abby, L. (2012). Systematic evaluation of variables that contribute to noncompliance: A replication and extension. *Journal of Applied Behavior Analysis, 45*(3), 607–611. https://doi.org/10.1901/jaba.2012.45-607

Merriam-Webster. (n.d.). Noncompliance. In *Merriam-Webster.com dictionary*. Retrieved December 12, 2021, from https://www.merriam-webster.com/dictionary/noncompliance

Miltenberger, R. G. (2016). *Behavior modification: Principles and procedures* (6th ed.). Cengage.

Miltenberger, R. G., Valbuena, D., & Sanchez, S. (2019). Functional assessment of challenging behavior. *Current Developmental Disorders Reports, 6*(4), 202–208. https://doi.org/10.1007/s40474-019-00180-y

Morris, C., Conway, A. A., & Goetz, D. B. (2021a). A review of effective strategies for parent-delivered instruction. *Behavior Analysis in Practice, 14*(2), 513–522. https://doi.org/10.1007/s40617-020-00525-9

Morris, C., Detrick, J. J., & Peterson, S. M. (2021b). Participant assent in behavior analytic research: Considerations for participants with autism and developmental disabilities. *Journal of Applied Behavior Analysis, 54*(4), 1300–1316. https://doi.org/10.1002/jaba.859

Muskett, A., Radtke, S., & Ollendick, T. H. (2020). Brief, intensive, and concentrated treatment of specific phobia in a child with minimally verbal autism spectrum disorder. *Clinical Case Studies, 19*(1), 3–16. https://doi.org/10.1177/1534650119880271

Ndoro, V. W., Hanley, G. P., Tiger, J. H., & Heal, N. A. (2006). A descriptive assessment of instruction-based interactions in the preschool classroom. *Journal of Applied Behavior Analysis, 39*(1), 79–90. https://doi.org/10.1901/jaba.2006.146-04

Neef, N. A., Shafer, M. S., Egel, A. L., Cataldo, M. F., & Parrish, J. M. (1983). The class specific effects of compliance training with "do" and "don't" requests: Analogue analysis and classroom application. *Journal of Applied Behavior Analysis, 16*(1), 81–99. https://doi.org/10.1901/jaba.1983.16-81

Nevin, J. A. (1996). The momentum of compliance. *Journal of Applied Behavior Analysis, 29*(4), 535–547. https://doi.org/10.1901/jaba.1996.29-535

Newman, Z. A., Roscoe, E. M., Errera, N. P., & Davis, C. R. (2021). Noncontingent reinforcement: Arbitrary versus maintaining reinforcers for escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 54*(3), 984–1000. https://doi.org/10.1002/jaba.821

Nipe, T. A., Dowdy, A., Quigley, J., Gill, A., & Weiss, M. J. (2018). Increasing the wearing of multiple prescription prosthetic devices. *Education and Treatment of Children, 41*(3), 331–343. https://doi.org/10.1353/etc.2018.0017

Normand, M. P., & Beaulieu, L. (2011). Further evaluation of response-independent delivery of preferred stimuli and child compliance. *Journal of Applied Behavior Analysis, 44*(3), 665–669. https://doi.org/10.1901/jaba.2011.44-665

Payne, S. W., & Dozier, C. L. (2013). Positive reinforcement as treatment for problem behavior maintained by negative reinforcement. *Journal of Applied Behavior Analysis, 46*(3), 699–703. https://doi.org/10.1002/jaba.54

Peyton, R. T., Lindauer, S. E., & Richman, D. M. (2005). The effects of directive and nondirective prompts on noncompliant vocal behavior exhibited by a child with autism. *Journal of Applied Behavior Analysis, 38*(2), 251–255. https://doi.org/10.1901/jaba.2005.125-04

Piazza, C. C., Fisher, W. W., Hanley, G. P., Remick, M. L., Contrucci, S. A., & Aitken, T. L. (1997). The use of positive and negative reinforcement in the treatment of escape-maintained destructive behavior. *Journal of Applied Behavior Analysis, 30*(2), 279–298. https://doi.org/10.1901/jaba.1997.30-279

Pitts, L., & Dymond, S. (2012). Increasing compliance of children with autism: Effects of programmed reinforcement for high-probability requests and varied inter-instruction intervals. *Research in Autism Spectrum Disorders, 6*(1), 135–143. https://doi.org/10.1016/j.rasd.2011.03.013

Radley, K. C., & Dart, E. H. (2016). Antecedent strategies to promote children's and adolescents' compliance with adult requests: A review of the literature. *Clinical Child and Family Psychology Review, 19*(1), 39–54. https://doi.org/10.1007/s10567-015-0197-3

Rajaraman, A., Austin, J. L., Gover, H. C., Cammilleri, A. P., Donnelly, D. R., & Hanley, G. P. (2021). Toward trauma-informed applications of behavior analysis. *Journal of Applied Behavior Analysis*. Advanced online publication. https://doi.org/10.1002/jaba.881

Randall, K. R., Lambert, J. M., Matthews, M. P., & Houchins-Juarez, N. J. (2018). Individualized levels system and systematic stimulus pairing to reduce multiply controlled aggression of a child with autism spectrum disorder. *Behavior Modification, 42*(3), 422–440. https://doi.org/10.1177/0145445517741473

Rapp, J. T. (2012, September 27–28). *Procedures for increasing passive compliance with hygiene-related tasks for individuals with autism* [Conference session]. Annual Meeting of the Minnesota Northland Association for Behavior Analysis.

Rapp, J. T. (2013, September 6–7). *Assessment and treatment of noncompliant behavior* [Conference session]. Four Points Behavioral Intervention Strategies.

Rapp, J. T., Vollmer, T. R., & Hovanetz, A. N. (2005). Evaluation and treatment of swimming pool avoidance exhibited by an adolescent girl with autism. *Behavior Therapy, 36*(1), 101–105. https://doi.org/10.1016/S0005-7894(05)80058-9

Reimers, T. M., Piazza, C. C., Fisher, W. W., Parrish, J. M., & Page, T. J. (1988). Enhancing child compliance with nebulized respiratory treatment: A case study. *Clinical Pediatrics, 27*(12), 605–608. https://doi.org/10.1177/000992288802701208

Ricciardi, J. N., Luiselli, J. K., & Camare, M. (2006). Shaping approach responses as intervention for specific phobia in a child with autism. *Journal of Applied Behavior Analysis, 39*(4), 445–448. https://doi.org/10.1901/jaba.2006.158-05

Richling, S. M., Rapp, J. T., Carroll, R. A., Smith, J. N., Nystedt, A., & Siewert, B. (2011). Using noncontingent reinforcement to increase compliance with wearing prescription prostheses. *Journal of Applied Behavior Analysis, 44*(2), 375–379. https://doi.org/10.1901/jaba.2011.44-375

Robinson, E. S., Desrochers, M., & Napolitano, D. A. (2019). Concurrent operant preference assessment to identify social consequences to decrease task latency for adolescents with dual diagnosis. *Behavioral Interventions, 34*(1), 52–61. https://doi.org/10.1002/bin.1648

Rodriguez, N. M., Thompson, R. H., & Baynham, T. Y. (2010). Assessment of the relative effects of attention and escape on noncompliance. *Journal of Applied Behavior Analysis, 43*(1), 143–147. https://doi.org/10.1901/jaba.2010.43-143

Rogalski, J. P., Roscoe, E. M., Fredericks, D. W., & Mezhoudi, N. (2020). Negative reinforcer magnitude manipulations for treating escape-maintained problem behavior. *Journal of Applied Behavior Analysis, 53*(3), 1514–1530. https://doi.org/10.1002/jaba.683

Romano, J. P., & Roll, D. (2000). Expanding the utility of behavioral momentum for youth with developmental disabilities. *Behavioral Interventions, 15*(2), 99–111. https://doi.org/10.1002/(SICI)1099-078X(200004/06)15:2<99::AID-BIN48>3.0.CO;2-K

Rortvedt, A. K., & Miltenberger, R. G. (1994). Analysis of a high-probability instructional sequence and time-out in the treatment of child noncompliance. *Journal of Applied Behavior Analysis, 27*(2), 327–330. https://doi.org/10.1901/jaba.1994.27-327

Runyan, M. C., Stevens, D. H., & Reeves, R. (1985). Reduction of avoidance behavior of institutionalized mentally retarded adults through contact desensitization. *American Journal of Mental Deficiency, 90*(2), 222–225.

Schumacher, B. I., & Rapp, J. T. (2011). Increasing compliance with haircuts in a child with autism. *Behavioral Interventions, 26*(1), 67–75. https://doi.org/10.1002/bin.321

Shabani, D. B., & Fisher, W. W. (2006). Stimulus fading and differential reinforcement for the treatment of needle phobia in a youth with autism. *Journal of Applied Behavior Analysis, 39*(4), 449–452. https://doi.org/10.1901/jaba.2006.30-05

Sivaraman, M., Virues-Ortega, J., & Roeyers, H. (2021). Telehealth mask wearing training for children with autism during the COVID-19 pandemic. *Journal of Applied Behavior Analysis, 54*(1), 70–86. https://doi.org/10.1002/jaba.802

Slocum, S. K., & Vollmer, T. R. (2015). A comparison of positive and negative reinforcement for compliance to treat problem behavior maintained by escape. *Journal of Applied Behavior Analysis, 48*(3), 563–574. https://doi.org/10.1002/jaba.216

Stephenson, K. M., & Hanley, G. P. (2010). Preschoolers' compliance with simple instructions: A descriptive and experimental evaluation. *Journal of Applied Behavior Analysis, 43*(2), 229–247. https://doi.org/10.1901/jaba.2010.43-229

Sturmey, P. (1994). Assessing the functions of aberrant behaviors: A review of psychometric instruments. *Journal of Autism and Developmental Disorders, 24*(3), 293–304. https://doi.org/10.1007/BF02172228

Tarbox, R. S. F., Wallace, M. D., Penrod, B., & Tarbox, J. (2007). Effects of three-step prompting on compliance with caregiver requests. *Journal of Applied Behavior Analysis, 40*(4), 703–706. https://doi.org/10.1901/jaba.2007.703-706

Thompson, R. H., & Iwata, B. A. (2007). A comparison of outcomes from descriptive and functional analyses of problem behavior. *Journal of Applied Behavior Analysis, 40*(2), 333–338. https://doi.org/10.1901/jaba.2007.56-06

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis, 21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Vermeire, E., Hearnshaw, H., Van Royen, P., & Denekens, J. (2001). Patient adherence to treatment: Three decades of research. A comprehensive review. *Journal of Clinical Pharmacy and Therapeutics, 26*(5), 331–342. https://doi.org/10.1046/j.1365-2710.2001.00363.x

Vollmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities, 13*(4), 393–417. https://doi.org/10.1016/0891-4222(92)90013-V

Vollmer, T. R., Peters, K. P., Kronfli, F. R., Lloveras, L. A., & Ibañez, V. F. (2020). On the definition of differential reinforcement of alternative behavior. *Journal of Applied Behavior Analysis, 53*(3), 1299–1303. https://doi.org/10.1002/jaba.701

Waranch, H. R., Iwata, B. A., Wohl, M. K., & Nidiffer, F. D. (1981). Treatment of a retarded adult's mannequin phobia through in vivo desensitization and shaping approach responses. *Journal of Behavior Therapy and Experimental Psychiatry, 12*(4), 359–362. https://doi.org/10.1016/0005-7916(81)90080-X

Waters, M. B., Lerman, D. C., & Hovanetz, A. N. (2009). Separate and combined effects of visual schedules and extinction plus differential reinforcement on problem behavior occasioned by transitions. *Journal of Applied Behavior Analysis, 42*(2), 309–313. https://doi.org/10.1901/jaba.2009.42-309

Wilder, D. A., & Atwell, J. (2006). Evaluation of a guided compliance procedure to reduce noncompliance among preschool children. *Behavioral Interventions, 21*(4), 265–272. https://doi.org/10.1002/bin.222

Wilder, D. A., Ertel, H., & Thomas, R. (2020). Further analysis of modifications to the three-step guided compliance procedure to enhance compliance among children with autism. *Journal of Applied Behavior Analysis, 53*(4), 2339–2348. https://doi.org/10.1002/jaba.721

Wilder, D. A., Fischetti, A. T., Myers, K., Leon-Enriquez, Y., & Majdalany, L. (2013). The effect of response effort on compliance in young children. *Behavioral Interventions, 28*(3), 241–250. https://doi.org/10.1002/bin.1362

Wilder, D. A., Harris, C., Reagan, R., & Rasey, A. (2007a). Functional analysis and treatment of noncompliance by preschool children. *Journal of Applied Behavior Analysis, 40*(1), 173–177. https://doi.org/10.1901/jaba.2007.44-06

Wilder, D. A., Majdalany, L., Sturkie, L., & Smeltz, L. (2015). Further evaluation of the high-probability instructional sequence with and without programmed reinforcement. *Journal of Applied Behavior Analysis, 48*(3), 511–522. https://doi.org/10.1002/jaba.218

Wilder, D. A., Myers, K., Fischetti, A., Leon, Y., Nicholson, K., & Allison, J. (2012). An analysis of modifications to the three-step guided compliance procedure necessary to achieve compliance among preschool children. *Journal of Applied Behavior Analysis, 45*(1), 121–130. https://doi.org/10.1901/jaba.2012.45-121

Wilder, D. A., Nicholson, K., & Allison, J. (2010). An evaluation of advance notice to increase compliance among preschoolers. *Journal of Applied Behavior Analysis, 43*(4), 751–755. https://doi.org/10.1901/jaba.2010.43-751

Wilder, D. A., Zonneveld, K., Harris, C., Marcus, A., & Reagan, R. (2007b). Further analysis of antecedent interventions on preschoolers' compliance. *Journal of Applied Behavior Analysis, 40*(3), 535–539. https://doi.org/10.1901/jaba.2007.40-535

Wood, C. L., Kisinger, K. W., Brosh, C. R., Fisher, L. B., & Muharib, R. (2018). Stopping behavior before it starts: Antecedent interventions for challenging behavior. *Teaching Exceptional Children, 50*(6), 356–363. https://doi.org/10.1177/0040059918775052

Zuluaga, C. A., & Normand, M. P. (2008). An evaluation of the high-probability instruction sequence with and without programmed reinforcement for compliance with high-probability instructions. *Journal of Applied Behavior Analysis, 41*(3), 453–457. https://doi.org/10.1901/jaba.2008.41-453

17

Teaching Adaptive Skills to Children with Autism Spectrum Disorder: From Assessment to Treatment

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Contents

Introduction

Independence is a fundamental goal for all individuals. Adaptive behaviors, often referred to as "self-help skills," refer to behaviors that are critical for self-management of an individual's health and independent living (Guerra, 2011) and are needed to navigate the demands of everyday life.

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The acquisition of adaptive skills in children with autism spectrum disorder (ASD) is among the most important to teach. These skills allow individuals to function independently in their environment all while accessing natural sources of reinforcement and fully participating in their community. In addition, mastery of these skills lead individuals to eventually gain meaningful employment and may result in less restrictive home and work environments, which can have significant positive effects on the individual's larger community. Acquisition of adaptive behaviors has also been demonstrated to lead to positive effects on work completion and overall decreases in maladaptive behavior (Shogren

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et al., 2004; Watanabe & Sturmey, 2003), both of which result in a more fulfilling life.

One of the hallmarks of applied behavior analysis (ABA) is to create meaningful change in the lives of the individuals in which it serves. This includes preparing individuals with ASD to function independently in their environment through the teaching of skills that lead to terminal behaviors useful to the individual in their natural setting (Bannerman et al., 1990). To do this, applied behavior analysts must incorporate adaptive skills into individualized educational programming and practice these skills on a regular basis.

ABA has a long history of teaching adaptive behaviors to individuals with ASD and related disabilities. In fact, the research on teaching adaptive skills dates back to the 1960s when Harris et al. (1964) first taught a 3.5-year-old child with ASD to wear his glasses. Since then, a wide variety of behavior analytic research has been published on applying the principles of learning in teaching adaptive behavior.

Adaptive behavior expectations for children with ASD include skills related to self-care, domestic, community, recreational, and social behavior, with the ability to *independently* engage in these skills central to the goal of learning (Estabillo & Matson, 2018). This wide variety of skills is frequently demanded in the domestic, vocational, and community environments all which result in a functional outcome for the individual. In this chapter, we will review the most commonly used assessment tools for assessing adaptive behavior repertoires, provide an overview of the most common adaptive behaviors when teaching in children with ASD, and provide an overview on systemic instruction related to how to teach adaptive behavior using an assessment to treatment model.

Assessment

Prior to the teaching of adaptive skills, applied behavior analysts must first conduct an assessment, with the goal of integrating assessment information when making clinical decisions. Assessment plays an integral role in the education of children with ASD and is central to the evaluation and planning of instruction. In fact, according to the Behavior Analyst Certification Board®, applied behavior analysts must adhere to professional and ethical code 2.13 (www.BACB.com) stating:

> 2.13 Selecting, Designing, and Implementing Assessments Before selecting or designing behavior-change interventions behavior analysts select and design assessments that are conceptually consistent with behavioral principles; that are based on scientific evidence; and that best meet the diverse needs, context, and resources of the client and stakeholders. They select, design, and implement assessments with a focus on maximizing benefits and minimizing risk of harm to the client and stakeholders. They summarize the procedures and results in writing.

Assessment may be used in identifying adaptive behavior educational goals for students with ASD and evaluating the extent to which students make progress towards and meet these goals. When program planning, there are a number of assessment and instructional planning tools specific to individuals with ASD and a handful of those are commonly used by behavior analysts in their practice (see Moore et al., 2007 for a detailed list). These allow for the evaluation of current levels of functioning and identify meaningful skills to target for intervention.

Criterion-referenced assessment tools have a rich history in the special education literature and are used to inform Individualized Education Program (IEP) development and behavior intervention plans. Criterion-referenced assessment results compare a person's skills against a predetermined standard or performance level. Each person's results are compared to this standard without considering how others perform on the assessment. On the contrary, norm-referenced assessments compare a person's skills against the skills of the normed group. This norm group is often a nationally representative sample (Montgomery & Connolly, 1987).

The *Assessment of Functional Living Skills* (AFLS®; Partington & Mueller, 2012) is a criterion-referenced assessment tool and curriculum guide comprised of six assessment modules designed to evaluate performance across the following domains: *Basic Living Skills, Home Skills, Community Participation Skills, School Skills, Vocational Skills, and Independent Living Skills* (see Table 17.1 for a detailed list of skills targeted within each module). The AFLS involves a guiding assessment, tracking grid, and a curriculum planning tool, and information is gathered through caregiver report, direct observation in the natural setting, and through contrived settings. The AFLS is appropriate for use with individuals through the lifespan (starting from 2 years of age).

The *Assessment of Basic Language and Learning Skills-Revised* (ABLLS®; Partington, 2010) is a criterion-referenced protocol and scoring guide and assists clinicians in developing individualized instructional goals related to the needs of the student. Although primarily conceptualized as a language assessment, the ABLLS-R® includes self-help and motor skill domains that are useful in assessing the adaptive behavior of children. The ABLLS-R® provides a review of 544 skills from 25 skill domains including *language, social interaction, self-help, academic, and motor skills*. The ABLLS® is geared for use with individuals from birth to 12 years of age.

The *Verbal Behavior Milestones Assessment and Placement Program* (VB-Mapp; Sundberg, 2008) is an assessment tool and curriculum guide based on B.F. Skinner's analysis of verbal behavior. Similar to the ABLLS-R®, the VB-Mapp is often conceptualized as a language-based assessment; however, the VB-Mapp includes domains across *language, social, play, self-help/adaptive, and motor skills.* The VB-Mapp is geared for use with individuals from birth to 48 months and the curriculum component is designed to be integrated into a learners' intervention plan or Individualized Education Program (IEP).

The *Essential for Living* (EFL; McGreevy et al., 2012) is a criterion-referenced and curriculum-based assessment and curriculum protocol for *communication, behavior, and adaptive skills* in preschoolers through adults. The EFL assesses eight skills, across seven domains, with one specific to the assessment of maladaptive behavior. The assessment and curriculum are designed to be integrated into a learner's intervention plan or Individualized Education Program (IEP).

The *Vineland Adaptive Behavior Scales*, Third Edition (Vineland III; Sparrow et al., 2008), is regarded as one of the most widely used adaptive behavior assessment tools and is designed to measure adaptive behavior in individuals from birth through 90 years old. The Vineland III is a norm-referenced assessment tool that has four forms, two of which (Survey and Expanded report forms) are completed through a structured interview with parents or caregivers and the remaining two (Parent/Caregiver and Teacher report forms) that involve completion of a rating form by teachers and/or parents and caregivers. The Vineland III is appropriate for use with individuals through the lifespan (birth to 90 years of age) and assesses performance across four domains, including *communication, daily living skills, socialization, and motor skills*. A Maladaptive Behavior Index is included to assess the degree to which maladaptive behavior is likely to interfere with skill performance. Items are rated on a 3-point Likert scale and raw scores yield age-normed standard scores, percentiles, and age equivalents.

The *Scales of Independent Behavior (SIB-R)* is a comprehensive measure of independence and adaptive functioning across multiple environments (i.e., home, school, community) from infancy to 80 years of old. The SIB-R is a norm-referenced tool and can be administered as a questionnaire or structured interview with family and caretakers of the individual. It includes 259 items, separated into 14 subscales, grouped into four clusters (Communication, Personal Living, Community Living, and Motor Skills).

The development of adaptive skills is among the most important skills to teach individuals with ASD and encompass a wide range of areas, including self-care, domestic, recreational, community, and pre-vocational/vocational skills. Upon completion of assessment, clinicians can select skills for teaching based on these assessment outcomes. The remainder of this chapter discusses a portion of the most common adaptive skills for teaching children with ASD and the

Table 17.1 Assessment tools

Instrument	Age range	Type of assessment	Domains
AFLS	2 years and up	Criterion-referenced	Basic living skills, home skills, community participation, school skills, vocational skills, independent living skills
ABLLS	0–12 years old	Criterion-referenced	Basic learner skills, academic skills, self-help skills, motor skills
VB-Mapp	0–48 months old	Criterion-referenced	Mand, tact, listener responding, visual perceptual skills, play, social, motor imitation, echoic, spontaneous vocal behavior, listener responding by feature, function and class, intraverbal, classroom routine and group skills, linguistic structure, textual, transcription and copying-a-text, math Includes additional domains across a Barrier and Transition assessment
EFL	Preschool-adulthood	Curriculum based, Criterion-referenced	Communication, language, daily living, social, functional academic, tolerating skills, problem behavior assessment
Vineland	0–90 years old	Norm-referenced	Communication, daily living skills, socialization, motor skills, maladaptive behavior
SIB-R	3 m–80 years old	Norm-referenced	Communication, personal living, community living, and motor skills

most common instructional interventions for targeting these skills.

Common Adaptive Behaviors for Instruction

Self-Care Skills

Self-care skills are among the most vital adaptive behaviors for children to learn as they are necessary to sustain one's own health and well-being. Self-care skills include specific targets such as toileting and hygiene (e.g., voiding successfully in the toilet, handwashing, cleaning after bowel movements, bathing, menstrual care), feeding (e.g., using vary utensils, drinking from a cup, absence of interfering behavior during mealtimes), and other independent care skills (e.g., hair-brushing, getting dressed independently). Below, we discuss a portion of these skills and the research surrounding how to most effectively teach these behaviors to children with ASD.

Toileting and bathroom hygiene is one of the earliest and most crucial adaptive skills in an individual's repertoire. In conjunction with acquiring successful voiding (Azrin & Foxx, 1971), children must also learn appropriate hygienic behaviors such as wiping after bowel movements (Byra et al., 2018), fastening and unfastening clothing, and washing hands (Jess & Dozier, 2020), all of which can play a role in increasing socialization with peers and eventually facilitate employment opportunities (Stokes et al., 2004).

Most of the current research on toilet training interventions for individuals with ASD are replications and modifications of Azrin and Foxx (1971). LeBlanc et al. (2005), for example, evaluated an intervention package with three children with ASD that consisted of wearing underwear (rather than diapers), a sitting schedule (on the toilet), positive and negative reinforcement, increased fluid consumption, functional communication training, wearing of a urine sensor, and reprimands delivered contingent upon accidents. Results of LeBlanc et al. (2005) demonstrated that all participants achieved continence and a portion of participants began initiating to void appropriately. More recently, Perez et al. (2020) extended a commonly used toilet training procedure first described by Greer et al. (2016), whereas children with ASD were exposed to a treatment package consisting of differential reinforcement, wearing underwear (rather than diapers), and a dense sitting schedule (on the toilet). Results indicated that this treatment package was effective for increasing appropriate urination across all participants.

Though associated with adulthood, menarche onset occurs well before individuals transition to adulthood and planning for menstrual care, as a seminal hygiene behavior, should begin well before the age of onset. Unfortunately, to date, there is very little empirical guidance for practitioners to initiate these teaching procedures. As a starting point, clinicians can refer to Veazey et al. (2016) who designed task analyses to teach three separate hygiene response chains (change soiled underwear; change soiled sanitary napkin; change both soiled underwear and sanitary napkin).

Approximately 25–35% of children with ASD develop a feeding disorder (Schreck et al., 2004). Factors that are suspected to contribute to the maintenance of feeding disorders in children with ASD are the concentration on details to food presentation, weaknesses in social compliance, biological food intolerance, parental reinforcement of poor eating/feeding patterns, and communication difficulties (Ledford & Gast, 2006). When feeding problems develop, the child's physical health can be significantly impacted, a family's routine altered, and increases in parental stress are reported. Furthermore, opportunities to contact reinforcement in the community for both child and parent are altered if a child has a highly restrictive diet or requires medical assistance, in the form of tube-feedings. The behavior analytic literature is rich in empirical guidance to assess and treat feeding problems in children with ASD (escape extinction, Piazza et al., 2003; blending, Mueller et al., 2004; texture fading, Shore et al., 1998; manipulation of utensil, Sharp et al., 2010; simultaneous presentation; Piazza et al., 2002) and can guide clinicians in treating a variety of behavior related to food refusal, selectivity, and self-feeding.

A review on treating feeding disorders in children with ASD (Ledford & Gast, 2006) synthesized the most current research on feeding interventions and prevalence and found a variety of interventions, including simultaneous presentation, sequential presentation, differential reinforcement of acceptance, stimulus fading, escape extinction, and appetite manipulation were used successfully in isolation or combination. Simultaneous presentation, for example, involves the presentation of a more preferred food along with the presentation of a less preferred food. This intervention is in contrast to sequential presentation whereas the preferred food is presented contingent upon the consumption of a less preferred food. Piazza et al. (2002) compared the effects of simultaneous and sequential presentation to increase consumption of a non-preferred food and found both methods to be successful in increasing food consumption. Clinicians should see Ledford and Gast (2006) or Seiverling et al. (2011) for a complete review of interventions to treat feeding disorders and increase self-feeding in children with ASD.

An overriding goal for all children with ASD is for them to function independently in completion of daily routines and self-care. Using empirically-sound methods to teach these complex skills allow for children with ASD to reach maximum success, therefore leading a more fulfilled life.

Domestic Skills

Domestic skills refer to common household behaviors and involve maintaining a home, completing chores (e.g., vacuuming, wiping down surfaces, making a bed), food preparation and food safety (e.g., cutting, using a microwave, meal preparation), and doing laundry (e.g., washing and drying, folding, ironing, and sorting clothing) (Domire & Wolfe, 2014).

Most domestic skills encompass a number of smaller component responses that are linked together in a chain of responses to be completed. For example, preparing food involves taking the food from its storage container, laying it out on a surface, assembling the meal or snack, etc. These skills require that children with ASD complete a number of steps before acquiring reinforcement. Therefore, teaching strategies such as independent activity schedule completion and video modeling or prompting are successful in teaching these complex chains. A review of the literature yields a number of studies dedicated to teaching domestic skills using a variety of techniques to *older* children with ASD and we encourage readers to see Matson et al. (2012) for a comprehensive review of these teaching interventions.

Recreational Skills

Recreational skills involve leisure engagement with one's environment and are important to enhancing one's quality of life and include activities that a child finds enjoyable such as games and sports (Thomas et al., 2016), engaging in video games (Kurnaz & Yanardag, 2018), watching television, or exercising (Kaplan-Reimer et al., 2011). Often, children with ASD need specific and direct teaching in how to engage recreationally in their environment and clinicians should be prepared to incorporate these skills in the child's educational plan. For example, Kaplan-Reimer et al. (2011) used an intervention package consisting of stimulus fading, errorless learning, positive reinforcement, error correction, and conditional discrimination training to teach two children with ASD to rock climb in an indoor rock-climbing gym. The results demonstrated that the children learned to climb an entire climb wall, providing a new leisure skill in their repertoire.

For individuals with ASD, the acquisition of leisure skills may be viewed as less critical when compared to academic or social skills; however, acquisition of these skills has been demonstrated to result in overall positive effects in one's social and emotional development (Williams & Dattilo, 1997). In fact, interviews and behavior observations conducted with children and adolescents with disabilities demonstrate an overall increase in their “positive affect,” with participants expressing satisfaction and overall “happiness” while engaging in leisure activities (Williams & Dattilo, 1997).

Several methods for teaching leisure skills have been demonstrated as effective for teaching leisure skills to children with ASD, including backward chaining (Jerome et al., 2007), time delay (Tekin-Iftar et al., 2001), and video-prompting (Banda et al., 2011). Along with effective intervention and acquisition of leisure skills, it is important to consider the child’s interest or preference for the leisure skills being taught. Preference assessments such as those evaluated by Hanley (2010) provide clinicians with an evidence-based way to assess preference of such skills prior to teaching.

Community and Pre-vocational Skills

It is critical for children to be able to access their environment safely and independently. Community skills involve the ability to cross the street safely, using public transportation (Mechling & O’Brien, 2010), making purchases in a store, identifying community helpers, and supporting when needed (e.g., seeking help when lost). Often considered pre-vocational skills, these behaviors allow children with ASD to navigate their surroundings with increased autonomy.

It is never too early to teach children with ASD community/pre-vocational skills necessary to be successful during adulthood and eventual employment (Seamon & Cannella-Malone, 2016). In fact, the significance of teaching students with ASD and related disabilities pre-vocational skills is so critical that the United States Department of Education (U.S. DOE) enacted the Individuals with Disabilities Education Act (IDEA, 2004). The IDEA (2004) ensures all children with disabilities receive a free and appropriate education (FAPE) and emphasizes access to special education and related services designed to meet their unique needs and prepare them for further *education, employment, and independent living*.

The research base for these skills remains somewhat limited and the bulk of what is available typically centers around teaching adolescents and adults these skills. What we do know is that adults with ASD are disproportionately under-employed and that effective teaching of these skills at the younger age level is crucial for success. Prevocational training provides learning and work experiences that include volunteer work, where the individual can develop several general, non-task-specific skills that will increase the likelihood of employability in competitive and paid integrated community settings, leading to more independence later in life.

Systematic Instruction

Instruction to teach children with ASD adaptive skills has primarily focused on the use of behavioral skills training (BST), video modeling/prompting, and chaining procedures in training a variety of responses.

Behavioral Skills Training (BST)

Behavioral skills training (BST) has been demonstrated to be one of the most widely used teaching intervention when establishing adaptive behavior repertoires in children with ASD and involves the use of instruction, modeling, role play, and feedback when teaching a variety of skills (Giannakakos et al., 2018; Houvouras & Harvey, 2014; Sarakoff & Sturmey, 2004). BST has been shown to be effective in teaching a wide range of adaptive behaviors in both children and adults with ASD (e.g., hygiene skills, Horner & Keilitz, 1975; leisure skills, Thomas et al., 2016; pre-vocational skills, Sump et al., 2019).

For example, Thomas et al. (2016) evaluated the use of BST on teaching a variety of skateboarding skills (e.g., turning to 360 degrees, and completing an “ollie”) to a young child with ASD. Mastery of these skills was demonstrated across multiple environments and skills were maintained following training. In a different vein, Sump et al. (2019) was successful in using BST to teach basic computer skills to an individual with ASD.

Video Modeling, Video-Based Instruction, and Video Prompting

Video modeling procedures involve showing individuals a video of a person engaging in the target response. The individual is then expected to engage in the behavior demonstrated (Keen et al., 2007). Video modeling has been used to teach a wide range of adaptive behavior to children with ASD, including self-help skills (e.g., Shipley-Benamou et al., 2002), domestic skills (e.g., Bereznak et al., 2012), and leisure activities (e.g., Blum-Dimaya et al., 2010). Similarly, video prompting involves presenting a series of brief clips of discrete behaviors in a lengthy behavior chain. Video prompting has been shown to be effective in teaching leisure behaviors (vocational skills, Bereznak et al., 2012; food preparation, and domestic skills, Sigafoos et al., 2007).

Chaining Procedures

Behavior chains are a sequence of responses that lead to a terminal outcome. In chaining procedures, the response for one portion of the chain serves as the conditioned reinforcer for that response and the discriminative stimulus for the next response in the chain (Cooper et al., 2020). Chaining, linking specific sequences and responses to form a new behavior, is one strategy to use to teach a complex skill, and the literature on teaching adaptive behaviors to children with ASD provides examples of how to effectively use chaining procedures to reach these goals.

Researchers have evaluated chaining procedures to teach hygiene tasks (e.g., menstruation care) to individuals with ASD (e.g., Veazey et al., 2016), leisure skills (e.g., Edwards et al., 2017), and domestic skills (e.g., Schuster et al., 1988). Veazey et al. (2016) used a chaining procedure to teach two adolescents with ASD feminine hygiene skills, consisting of, changing their underwear and sanitary napkin. The intervention consisted of a using a total task chaining procedure, where the individual was given the opportunity to complete all steps in the task analysis and a forward chaining procedure, where each component of the task analysis of steps was targeted in sequential order. Both participants acquired all skills in the chain and one demonstrated generalized responding to novel stimuli.

Conclusion

Adaptive skills are critical for children with ASD and mastery of these skills can lead to increased independence and the option to fully participate in their community. Teaching adaptive skills is a lifelong process and involves focusing on a range of areas including self-care, domestic, leisure, community, and pre-vocational skills. The absence of these skills may lead to placements in more restrictive settings, resulting a greater demand on caregivers and the community.

There exists a number of assessment tools, both criterion and norm-referenced, that are widely available to clinicians to guide selection of adaptive behavior targets in teaching children with ASD. Completion of these assessments, along with gathering parent/caregiver input, may allow clinicians to identify a child's adaptive behavior strengths and weaknesses and to plan for instruction.

References

Azrin, N. H., & Foxx, R. M. (1971). A rapid method of toilet training the institutionalized retarded. *Journal of Applied Behavior Analysis, 4*(2), 89–99. https://doi.org/10.1901/jaba.1971.4-89

Banda, D. R., Dogoe, M. S., & Matuszny, R. M. (2011). Review of video prompting studies with persons with developmental disabilities. *Education and Training in Autism and Developmental Disabilities, 46*, 514–527.

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The right of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Behavior Analysis, 23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Bereznak, S., Ayres, K. M., Mechling, L. C., & Alexander, J. L. (2012). Video self-prompting and mobile technology to increase daily living and vocational independence for students with autism spectrum disorders. *Journal of Developmental and Physical Disabilities, 14*, 269–285. https://doi.org/10.1007/s10882-012-9270-8

Byra, K. L., White, S., Temple, M., & Cameron, M. J. (2018). An approach to cleanliness training to support bathroom hygiene among children with autism spectrum disorder. *Behavior Analysis and Practice, 11*(2), 139–143. https://doi.org/10.1007/s40617-017-0205-9

Blum-Dimaya, A., Reeve, S. A., Reeve, K. F., & Hoch, H. (2010). Teaching children with autism to play a video game using activity schedules and game-embedded simultaneous video modeling. *Education and Treatment of Children, 33*(3), 351–370. https://doi.org/10.1353/etc.0.0103

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied Behavior Analysis (3rd Edition)*. Hoboken, NJ: Pearson Education.

Domire, S. C., & Wolfe, P. (2014). Effects of video prompting techniques on teaching daily living skills to children with autism Spectrum disorders: A review. *Research and Practice for Persons with Severe Disabilities, 39*(3), 211–226. https://doi.org/10.1177/1540796914555578

Edwards, C. K., Landa, R. K., Frampton, S. E., & Shillingsburg, A. (2017). Increasing functional leisure engagement for children with autism using backward chaining. *Behavior Modification, 42*(1), 9–33. https://doi.org/10.1177/0145445517699929

Estabillo, J. A., & Matson, J. L. (2018). Adaptive and developmental behavior scales. In J. Matson (Ed.), *Handbook of childhood psychopathology and developmental disabilities assessment* (Autism and child psychopathology series). Springer. https://doi.org/10.1007/978-3-319-93542-3_5

Giannakakos, A. R., Vladescu, J. C., & Simon, R. (2018). Teaching installation and use of child passenger safety restraints. *Journal of Applied Behavior Analysis, 51*(4), 915–923. https://doi.org/10.1002/jaba.493

Greer, B. D., Neidert, P. M., & Dozier, C. L. (2016). A component analysis of toilet-training procedures recommended for young children. *Journal of Applied Behavior Analysis, 49*(1), 1–16. https://doi.org/10.1002/jaba.275

Guerra, N. S. (2011). Activity of daily living. In S. Goldstein & J. A. Naglieri (Eds.), *Encyclopedia of child behavior and development*. Springer. https://doi.org/10.1007/978-0-387-79061-9

Hanley, G. P. (2010). Toward effective ad preferred programming: A case for the objective measurement of social validity with recipients of behavior-change programs. *Behavior Analysis and Practice, 3*(1), 13–21. https://doi.org/10.1007/BF03391754

Harris, F. R., Wolf, M. M., & Baer, D. M. (1964). Effects of adult social reinforcement on child behavior. *Young Children, 20*(1), –17.

Horner, R. D., & Keilitz, I. (1975). Training mentally retarded adolescents to brush their teeth. *Journal of Applied Behavior Analysis, 8*(3), 301–309. https://doi.org/10.1901/jaba.1975.8-301

Houvouras, A. J., & Harvey, M. T. (2014). Establishing fire safety skills using behavioral skills training. *Journal of Applied Behavior Analysis, 47*(2), 420–424. https://doi.org/10.1002/jaba.113

Individuals with Disabilities Education Act, 20 U.S.C. § 1400 (2004).

Jerome, J., Frantino, E. P., & Sturmey, P. (2007). The effects of errorless learning and backward chaining on the acquisition of internet skills in adults with developmental disabilities. *Journal of Applied Behavior Analysis, 40*(1), 185–189. https://doi.org/10.1901/jaba.2007.41-06

Jess, R. L., & Dozier, C. L. (2020). Increasing handwashing in young children: A brief review. *Journal of Applied Behavior Analysis, 53*(3), 1219–1224. https://doi.org/10.1002/jaba.732

Kaplan-Reimer, H., Sidener, T. M., Reeve, K. F., & Sidener, D. W. (2011). Using stimulus control procedures to teach indoor rock climbing to children with autism. *Behavioral Interventions, 26*, 1–22. https://doi.org/10.1002/bin.315

Keen, D., Brannigan, K. L., & Cuskelly, M. (2007). Toilet training for children with autism: The effects of video modeling. *Journal of Developmental and Physical Disabilities, 19*, 291–303. https://doi.org/10.1007/s10882-007-9044-x

Kurnaz, E., & Yanardag, M. (2018). The effectiveness of video self-modeling in teaching active video game skills to children with autism spectrum disorder. *Journal of Developmental Physical Disabilities, 30*, 455–469. https://doi.org/10.1007/s10882-018-9596-y

LeBlanc, L. A., Carr, J. E., Crossett, S. E., Bennett, C. M., & Detweiler, D. D. (2005). Intensive outpatient behavioral treatment of primary urinary incontinence of children with autism. *Focus on Autism and Other Developmental Disabilities, 20*(2), 98–105.

Ledford, J. R., & Gast, D. L. (2006). Feeding problems in children with autism spectrum disorder. A review. *Focus on Autism and Other Developmental Disabilities, 21*(3), 153–166. https://doi.org/10.1177/10883576060210030401

Matson, J. L., Hattier, M. A., & Belva, B. (2012). Treating adaptive living skills of person with autism using applied behavior analysis: A review. *Research in Autism Spectrum Disorder, 6*(1), 271–276. https://doi.org/10.1016/j.rasd.2011.05.008

McGreevy, P., Fry, T., & Cornwall, C. (2012). Essential for living: A communication, behavior and functional skills curriculum, assessment, skill-tracking instrument, and professional practitioner's handbook for children and adults with moderate-to-severe disabilities.

Mechling, L., & O'Brien, E. (2010). Computer-based video instruction to teach students with intellectual disabilities to use public bus transportation. *Education and Training in Autism and Developmental Disabilities, 45*(2), 230–241. http://www.jstor.org/stable/23879809

Montgomery, P. C., & Connolly, B. H. (1987). Norm-referenced and criterion-referenced tests: Use in pediatrics and application to task analysis of motor skill. *Physical Therapy, 67*(12), 1873–1876. https://doi.org/10.1093/ptj/67.12.1873

Moore, D. J., Palmer, B. W., Patterson, T. L., & Jeste, D. V. (2007). A review of performance-based measures of functional living skills. *Journal of Psychiatric Research, 41*(1), 97–118. https://doi.org/10.1016/j.jpsychires.2005.10.008

Mueller, M. M., Piazza, C. C., Patel, M. R., Kelley, M. E., & Pruett, A. (2004). Increasing variety of foods consumed by blending nonpreferred foods into preferred foods. *Journal of Applied Behavior Analysis, 37*(2), 159–170. https://doi.org/10.1901/jaba.2004.37-159

Partington, J. W. (2010). *The ABLLS-R. the assessment of basic language and learning skills-revised*. Behavior Analysts, Inc.

Partington, J. W., & Mueller, M. M. (2012). *AFLS. The assessment of functional living skills*. Stimulus Publications.

Perez, B. C., Bacotti, J. K., Peters, K. P., & Vollmer, T. R. (2020). An extension of commonly used toilet-training procedures to children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 53*(4), 2360–2375. https://doi.org/10.1002/jaba.727

Piazza, C. C., Patel, M. R., Santana, C. M., Goh, H. L., Delia, M. D., & Lancaster, B. M. (2002). An evaluation of simultaneous and sequential presentation of preferred and nonpreferred food to treat food selectivity. *Journal of Applied Behavior Analysis, 35*(3), 259–270. https://doi.org/10.1901/jaba.2002.35-259

Piazza, C. C., Fisher, W. W., Brown, K. A., Shore, B. A., Patel, M. R., Katz, R. M., Sevin, B. M., Gulotta, C. S., & Blakely-Smith, A. (2003). Functional analysis of inappropriate mealtime behaviors. *Journal of Applied Behavior Analysis, 36*(2), 187–204. https://doi.org/10.1901/jaba.2003.36-187

Sarakoff, R. A., & Sturmey, P. (2004). The effects of behavioral skills training on staff implementation of discrete-trial teaching. *Journal of Applied Behavior Analysis, 37*(4), 535–538. https://doi.org/10.1901/jaba.2004.37-535

Schreck, K. A., Williams, K., & Smith, A. F. (2004). Assessment of feeding problems in children with autism spectrum disorders. *Journal of Developmental and Physical Disabilities, 22*, 403–413. https://doi.org/10.1007/s10882-010-9206-0

Schuster, J. W., Gast, D. L., Wolery, M., & Guiltinan, S. (1988). The effectiveness of a constant time delay procedure to teach chained responses to adolescents with mental retardation. *Journal of Applied Behavior Analysis, 21*(2), 169–178. https://doi.org/10.1901/jaba.1988.21-169

Seaman, R. L., & Cannella-Malone, H. I. (2016). Vocational skills interventions for adults with autism spectrum disorder: A review of the literature. *Journal of Developmental and Physical Disabilities, 28*, 479–494. https://doi.org/10.1007/s10882-016-9479-z

Seiverling, L. J., Williams, K. E., Ward-Horner, J., & Sturmey, P. (2011). Interventions to treat feeding problems in children with autism Spectrum disorders: A comprehensive review. In J. Matson & P. Sturmey (Eds.), *International handbook of autism and pervasive developmental disorders* (Autism and Child Psychopathology Series). Springer. https://doi.org/10.1007/978-1-4419-8065-6_31

Shipley-Benamou, R., Lutzker, J. R., & Taubman, M. (2002). Teaching daily living skills to children with autism through instructional video modeling. *Journal of Positive Behavior Interventions, 4*(3), 165–175. https://doi.org/10.1177/109830070200400305 01

Sharp, W.G., Harker, S., & Jaquess, D.L. (2010). Comparison of bite-presentation methods in the treatment of food refusal. *Journal of Applied Behavior Analysis, 43*(4), 739–743. https://doi.org/10.1901/jaba.2010.43-739

Shogren, K. A., Fagella-Luby, M. N., Bae, S. J., & Wehmeyer, M. L. (2004). The effect of choice-making as an intervention for problem behavior: A meta-analysis. *Journal of Positive Behavior Interventions, 6*(4), 228–237. https://doi.org/10.1177/10983007040060040401

Shore, B.A., Babbitt, R.L., Williams, K.E., Coe, D.A., & Snyder, A. (1998). Use of texture fading in the treatment of food selectivity. *Journal of Applied Behavior Analysis, 31*, 621–633. https://doi.org/10.1901/jaba.1998.31-621

Sigafoos, J., O'Reilly, M., Cannella, H., Edrisinha, C., de la Cruz, B., Upadhyaya, M., et al. (2007). Evaluation of a video prompting and fading procedure for teaching dish washing skills to adults with developmental disabilities. *Journal of Behavioral Education, 16*, 93–109. https://doi.org/10.1007/s10864-006-9004-z

Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2008). *Vineland adaptive behavior scales: (Vineland II), the expanded interview form*. Livonia, MN: Pearson Assessments.

Stokes, J. V., Cameron, M. J., Dorsey, M. F., & Fleming, E. (2004). Task analysis, correspondence training and general case instruction for teaching personal hygiene skills. *Behavioral Interventions, 19*(2), 121–135. https://doi.org/10.1002/BIN.153

Sump, L. A., Mottau, B. C., & LeBlanc, L. A. (2019). Evaluating behavioral skills training to teach basic computer skills to a young adult with autism. *Behavior Analysis and Practice, 12*(2), 331–334. https://doi.org/10.1007/s40617-018-00295-5

Sundberg, M. L. (2008). *VB-MAPP: Verbal behavior milestones assessment and placement program*. AVB Press.

Tekin-Iftar, E., Kircaali-Iftar, G., Birkan, B., Uysal, A., Yildirim, S., & Kurt, O. (2001). Using a constant delay to teach leisure skills to children with developmental disabilities. *Revista Mexicana de Análisis de la Conducta, 27*, 337–362.

Thomas, B. R., Lafasakis, M., & Spector, V. (2016). Brief report: Using behavioral skills training to teach skateboarding skills to a child with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*, 3824–3829. https://doi.org/10.1007/s10803-016-2900-8

Veazey, S. E., Valentino, A. L., Low, A. I., McElroy, A. R., & LeBlanc, L. (2016). Teaching feminine hygiene skills to young females with autism spectrum disorder and intellectual disability. *Behavior Analysis in Practice, 9*(2), 184–189. https://doi.org/10.1007/s40617-015-0065-0

Watanabe, M., & Sturmey, P. (2003). The effect of choice-making opportunities during activity schedules on task engagement of adults with autism. *Journal of Autism and Developmental Disorders, 33*(5), 535–538. https://doi.org/10.1023/a:1025835729718

Williams, R., & Dattilo, J. (1997). Effects of leisure education on self-determination, social interaction, and positive affect of young adults with mental retardation. *Therapeutic Recreation Journal, 33*, 244–258.

18 Toe Walking

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Introduction

Toe walking is defined as a pattern of ambulation characterized by a bilateral toe-to-toe gait which results in failure to make heel contact with the ground (Sala et al., 1999). Although toe walking is exhibited by some typically developing children, and is most common in early childhood, it is not considered pathologic unless it occurs after age 2 (Matthew & Sean, 2012). In some cases, toe walking may be caused by muscle or spinal abnormalities, but often the cause is unknown. When the specific cause of toe walking is

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unknown, the condition is called idiopathic toe walking (ITW; Sala et al., 1999).

ITW is most common among children with autism spectrum disorder (ASD; Barrow et al., 2011; Ming et al., 2007; Sala et al., 1999). A number of studies have assessed the prevalence of toe walking among children diagnosed with ASD. Barrow et al. (2011) evaluated a cohort of 954 children and found that approximately 20.1% of the cohort engaged in toe walking. Of the total 954 participants, 324 children had previously been diagnosed with ASD. The researchers found a 10% greater prevalence of toe walking in participants diagnosed with ASD relative to children without an ASD diagnosis. Additionally, Ming et al. (2007) assessed the prevalence of a variety of motor impairments in children diagnosed with ASD. In this study, the researchers found that among 154 participants between the ages 2 and 18 years, 19% engaged in toe walking. Taken together, the results of these studies suggest that approximately 20% of individuals diagnosed with ASD engage in toe walking.

Persistent ITW after a child is 3 years of age may lead to a myriad of physical problems that can cause pain and decrease range of motion (ROM). Some medical problems include tightening or shortening of the ankle or calf muscles, abnormal gait and posture, foot and ankle deformities, and foot pain and joint stiffness, fatigue, limping, and bunions (Engelbert et al., 2011; Sobel et al., 1997). In addition to medical and structural problems, ITW can be socially stigmatizing, particularly for older individuals (Berger et al., 2021), and can lead to decreased exercise levels and poor sports performance (Caserta et al., 2019). Thus, it is important to treat ITW.

Measuring ITW

Measuring ITW can be challenging and time-consuming as young children often change gait speeds, meander when walking from locations, and even jump while walking. These challenges have led researchers to use both direct and indirect measurement techniques. Direct measurement occurs when the behavior of interest is the same as the measurement (e.g., number of ITW steps) (Cooper et al., 2020). Most studies using direct measurement incorporate it with video recording or utilize a data collection system. Conversely, indirect measurement focuses on something other than directly measuring the primary topography and often involves the use of questionnaires or surveys. Overall, directly measuring ITW is a more sensitive and valid way to measure the behavior.

Direct Measures

In behaviorally-based studies, ITW measurement requires direct observation. In continuous measurement, researchers count the number of appropriate steps and inappropriate steps. Appropriate steps are defined as steps with heel-to-toe gait or heel strike, whereas inappropriate steps are often defined as those with toe-to-toe gait or forefoot strike (Hodges et al., 2018, 2019; Lancioni et al., 2012; Persicke et al., 2014; Wilder et al., 2020). The percentage of ITW steps is obtained by dividing the total number of steps by the number of inappropriate steps, then multiplying by 100. Most behavioral studies have measured ITW by providing a percentage of appropriate or inappropriate steps taken based on a predetermined step requirement.

Some behavioral studies have used discontinuous measures such as partial interval recording to measure ITW. For example, Hirst et al. (2019) divided the 30-minute observation time into 15-second observation bins in which any instance of ITW was scored as an occurrence. Conversely, a nonoccurrence was scored if the participant remained flat-footed or walked with an appropriate heel-to-toe gait. The percentage of intervals with ITW (occurrence) was calculated by dividing the total number of bins with ITW (occurrences) by the total number of intervals (occurrences + nonoccurrence) and multiplying by 100.

Video recording devices and slow-motion replay are useful tools for capturing subtle behavior and are therefore common in the assessment of toe walking within behavioral research. For example, Persicke et al. (2014) utilized a video camera to assess the toe walking of a 4-year-old child diagnosed with ASD, wherein they recorded the participant walking down 6 m stretches of a hallway. Additionally, other researchers have utilized a cell phone camera affixed to a selfie stick to capture toe walking responses in-vivo (Hodges et al., 2018, 2019; Wilder et al., 2020).

Another approach that behavioral researchers have taken to measure toe walking is to assess the acoustical response-products of a typical gait pattern rather than rely on visual observation. For example, Marcus et al. (2010) and Wilder et al. (2020) listened for a squeak sound produced by a Gaitspot Auditory Squeaker™ training device. The device was affixed to the heel of the participant's shoe and emitted a detectable sound each time the heel contacted the ground. These studies cleverly utilized the squeak sound as both a behavioral measure and as a component of the independent variable by pairing the sound with positive reinforcement.

The primary measure of interest when evaluating ITW in the medical literature is the ankle dorsiflexion range of motion (ROM; see Fig. 18.1). A lack of dorsiflexion ROM is often referred to as a tight heel cord. Barrow et al. (2011) classified a tight heel cord as a heel cord that did not extend beyond 90 degrees in dorsiflexion while in a seated position. A universal goniometer, which is an instrument used to measure angles, is often used to determine the exact ankle ROM in different positions, such as the knee extended and knee flexed 90 degrees (Berger et al., 2021; Shetreat-Klein et al., 2014; Valagussa et al., 2020).

Secondary measures in the medical literature on ITW include gait analyses that may include stride length, speed, cadence, strength, hip rotations, and foot patterns (see Caserta et al. (2019) for a review). There are automated systems (e.g., Gait Rite®, Coda-3 motion analysis system, Vicon motion system) that can precisely and reliably calculate all the aforementioned measures. According to Caserta et al. (2019), ROM and gait analysis outcomes are more prevalent in studies in which an intervention is evaluated relative to descriptive studies.

Indirect Measures

Although direct, continuous measurement is the preferred method of measuring ITW, a majority of the medical studies report using indirect measures such as questionnaires to estimate the severity of ITW. For example, the Alvarez classification tool (Alvarez et al., 2007) is one of the most frequently cited questionnaires (Caserta et al., 2019). Also, the aforementioned gait analyses can involve rating scales that estimate the severity of ITW.

Finally, many studies have reported measurement reliability or estimates of measurement accuracy. The behavioral studies using direct measurement all reported high levels of interobserver agreement. Some medical studies also report measuring reliability of the dependent variable. For example, Ali et al. (2020) investigated the reliability of gait analysis ratings. These researchers used ratings for a variety of body movements (i.e., head, trunk, arm) and different

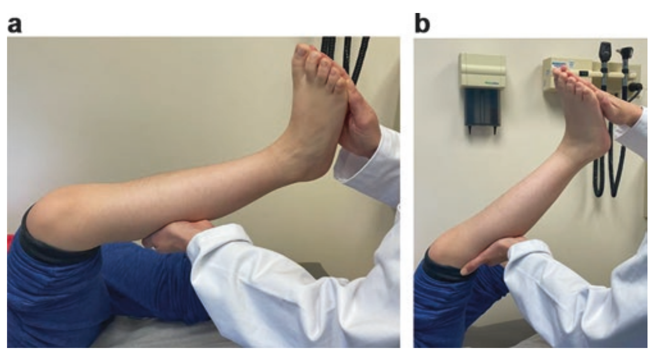

Fig. 18.1 (**a**) Ankle dorsiflexion with knee flexed; (**b**) Ankle dorsiflexion with knee extended

surfaces (linoleum, textured, balance beam, obstacle course) used in their assessment. The results showed high levels of agreement for foot, head, and trunk movements; moderate levels of agreement were reported for arm movements. Moreover, when assessments were conducted on linoleum, high levels of agreement were reported. Moderate levels were reported for textured surfaces and a balance beam, and relatively lower levels for an obstacle course. In conclusion, accurate and valid measurement tools are critical in assessing, treating, and evaluating ITW and should be the focus of future research.

Medical Assessment of ITW

Given the complexity involved with some individuals who engage in ITW (some have have an intellectual disability (ID) and / or ASD), medically assessing ITW properly is paramount in determining treatment options. This process includes obtaining medical and developmental information, consulting with medical providers, ruling out any other underlining medical conditions, and determining when to refer to other medical specialists. For example, Hayes et al. (2018) found that 62% of patients with ITW who were referred to neurology by orthopedic surgeons had an underlying neurological etiology (e.g., cerebral palsy, neuropathy, ASD). Engström and Tedroff (2012) found that 41.2% of children who exhibited ITW at 5 years of age also had a psychiatric diagnosis or a developmental delay. Therefore, it is essential for medical professionals, parents, psychologists, and behavior analysts to collaborate during assessment and intervention phases.

Informant-Based Assessment

Medical providers typically conduct informant-based assessments on ITW with caregivers due to the child's age. Caregivers serve as historians for their child's developmental milestones and medical concerns. Obtaining medical records that include gait analysis or baseline ROM data is most vital. The ROM data often indicate the severity of ITW and may report treatment gains or regression. During the structured interviews, basic questions should include the onset of ITW, specific activities that evoke ITW (e.g., walking, running), and family history of ITW. Pomarino et al. (2017) developed an interview checklist to determine the family history of ITW in specific family members, the onset of ITW (i.e., X number of months or years after walking), and current ITW status.

Other ITW assessment tools provide slightly more information. For example, Accardo and Barrow (2015) created a questionnaire to obtain historical data on ITW and ROM. This tool scores the presence of ITW on a 3-point Likert scale and scores ROM on a 2-point Likert Scale.

Direct Assessment

Direct observation is often the next step in medically evaluating ITW, and most studies include this assessment step. Observations include analyzing the individual's gait, both walking and running. It is often advantageous to observe individuals when they are unaware of the analysis, as awareness can temporarily alter gait (Bishop, 2016). Medical providers also conduct a physical exam that includes ROM data on the hips, knees, and ankles. These measurements are necessary because individuals who engage in ITW are three times more likely to have dorsiflexion ROM limitations (Pomarino et al., 2017). It is essential to ensure the direct assessment conditions capture the conditions under which ITW is likely to occur. Most observations occur at the time of medical visits; however, some studies used prerecorded videos to evaluate ITW (McMulkin et al., 2006). Unfortunately, assessing ITW, either in vivo or from video recordings, can be cumbersome and time-consuming.

Questionnaires are the most straightforward guide for clinicians. Williams et al. (2011) developed a 28-item ITW questionnaire to screen individuals for underlying medical issues, guiding primary care physicians on referring to other specialties. This tool requires physicians to observe the patient walking, standing up from a seated position, and tests reflexes and muscle tightness (i.e., hamstrings, hip flexors, gastrocnemius, and soleus muscles). Next, the clinician screens patients from a pre-recorded assessment. The results of a study evaluating the questionnaire indicated that all clinicians correctly identified all individuals with underlying medical conditions (Williams et al., 2011); however, this tool may not yet be commonly utilized by medical professionals.

Other researchers have created assessment tools to quantify ITW severity. As previously mentioned, Alvarez et al. (2007) developed one of the most cited severity assessment tools. As part of this study, the researchers classified ITW severity into three distinct categories: mild, moderate, or severe. The severe group demonstrated the most restrictive ankle ROM.

Brief medical exams can fail to capture the severity or even the occurrence of ITW. Therefore, Pomarino et al. (2017) created an assessment tool that was more likely to capture ITW. Their assessment included various movement conditions to evoke ITW, in addition to ROM measures; they tested the assessment tool across 836 individuals with ITW and compared this group to 55 participants with a normal gait in a control group. A spin test required the physician to quickly spin the individual around in one spot, starting with one spin and adding a spin until the participant reached a maximum of 10 spins. After each spin, physicians instructed the participants to walk 10 steps and recorded the step number on which ITW occurred. The test is considered positive if the participant engages in ITW after any of the spins. In the next condition, participants were instructed to walk on their heels. Clinicians examined performance during heel walking and the adjustments made to achieve heel walking (i.e., a forward inclination of the trunk, ankle dorsiflexion ability). In the third test, ROM was assessed in different positions.

Technology can alleviate some of the challenges in measuring and monitoring ITW. For example, Kim et al. (2019) assessed wearable sensors attached to participants' lower back to measure ITW. The device differentiated ITW from heel-toe gait with 82% accuracy across 3 days. Other researchers have successfully assessed ITW with kinesiological electromyography (EMG) (Thielemann et al., 2019) and three-dimensional gait analysis (McMulkin et al., 2006). Unfortunately, this technology can be cost-prohibitive.

Given the prevalence of ITW in individuals with ID, individuals who exhibit ITW may require additional medical assessments. Often, individuals with ID require magnetic resonance imaging (MRI) or genetic testing. MRIs of the brain and spine examine any underlying neurological or neuromuscular causes of ITW, and a neurologist or neurosurgeon typically manages these cases (Bishop, 2016).

Experimental Assessments

Medical studies have examined variables that may contribute to ITW, such as various gait speeds, flooring types, and vibration sensitivity thresholds. For example, Fanchiang et al. (2016) evaluated the effects of different surfaces (i.e., vinyl tile, carpet, pea gravel) on barefoot gait patterns of participants (n = 30) between 4 and 10 years of age. Fifteen participants served in the ITW group and 15 typically-developing individuals served as age-matched peers without ITW. Exclusionary criterion included participants with neuromotor or musculoskeletal disorders. Motion system analysis recorded gait measures as the participants walked across each of the four surface types. Results showed similar gait patterns across different surfaces for both groups and no significant differences across age. Pea gravel produced no initial toe-contact, which resulted in decreased ITW.

Valagussa et al. (2020) expanded previous research by examining how gait speed and surface type affect ITW. The first experiment examined ITW during standing, walking, and running in 69 individuals with ASD. In the standing condition, participants had access to preferred toys while they stood in front of a table. To assess

ITW during running and walking, the experimenter instructed the participants to either walk or run 10 m three times across 3 days. The second experiment assessed the cumulative number of seconds allocated to (1) tiptoes, (2) both full feet support, (3) one full foot support on a hard surface (i.e., linoleum floor), and a soft surface (i.e., foam mat). Participants included 14 individuals with ASD (7 with ITW and 7 without ITW). Exclusionary criteria included any participant who exhibited an ankle dorsiflexion ROM of less than 90°. Results show 10 participants (14.49%) engaged in ITW across all three conditions. Surface assessment results showed a higher occurrence of ITW on hard surfaces (78.77%) versus soft surfaces (37.30%) for participants for the ITW group; the non-ITW group never engaged in ITW. These findings have implications for possible less intrusive interventions, such as modifying shoe type.

More recently, Michalitsis et al. (2019) used GaitRite® technology to compare ITW for 15 participants during three different conditions: barefoot, usual play shoes, and rigid carbon fire foot orthoses inside high-top boots. Overall, appropriate heel strike occurred on 64% of steps in the barefoot condition, 68% of steps in the play shoes, and 89% of steps in the foot orthoses plus high-top condition. However, 20% of participants did not engage in ITW during any of the conditions despite exhibiting ITW during the pre-treatment observation, and ITW varied across conditions for each participant.

In conclusion, researchers have examined several variables that can alter ITW, such as surface type (Fanchiang et al., 2016; Valagussa et al., 2020), shoes (Michalitsis et al., 2019), and gait speed (Valagussa et al., 2020). Additional research is needed to replicate surface and gait speed assessment results and expand assessment to include alternative surfaces and shoes. In addition, in the medical literature, researchers should continue to evaluate the validity and reliability of measurement tools and collaborate across disciplines (Ali et al., 2020).

Medical Interventions for ITW

Medical treatments for ITW vary in invasiveness and include surgery (Hemo et al., 2006), serial casting (Fox et al., 2006; Stott et al., 2004), Botulinum Toxin A (Engström et al., 2010, 2013; Sätilä et al., 2016), orthoses (Herrin & Geil, 2016), and watch and wait (Davies et al., 2018).

Surgical Interventions

Surgery is the most invasive and expensive ITW treatment. Surgeons aim to achieve at least 10° ankle dorsiflexion (McMulkin et al., 2006) by carefully lengthening the Achilles tendon, which tightens due to toe walking (Hall et al., 1967). This procedure has a positive success rate for ITW among individuals who have experienced failure of other treatment modalities (van Bemmel et al., 2014). However, treatment outcomes for individuals with ASD are less promising than those without an ASD diagnosis. In fact, Leyden et al. (2019) found that 75% of ASD individuals resumed ITW within 2 years of surgery. Unfortunately, individuals with ASD receive surgical treatment nearly three times more often than those with ITW without an ASD diagnosis (Leyden et al., 2019). Other interventions are often skipped due to concerns about perceived sensory issues with tolerating less invasive treatments (e.g., serial casting, orthoses). Thus, it is essential to educate caregivers and medical professionals on the treatment outcomes within this population.

Surgery imposes sedation risks as well as wound or recovery risks. Van Bemmel et al. (2014) reviewed 10 studies that compared surgery to casting, and only six of the studies (N = 180 patients) provided data on complications (61 casts, 119 surgery). Follow-up data were reported at 2.5 years for the casting group and 4.1 years for the surgical group. Only 3.3% of participants in the casting studies reported complications compared to 6.7% of participants in the surgery studies.

Hemo et al. (2006) conducted parent interviews post-surgery (M = 2.9 years, range = 1.1–6.0 years). Twelve of 16 parents reported that their child consistently walked with a normal gait, but three parents said their child occasionally engaged in ITW. One participant experienced Achilles tendonitis 6 years post-surgery and required casting to correct ITW. Additional studies have reported high parental satisfaction post-surgery (Stott et al., 2004; van Bemmel et al., 2014).

Serial Casting

Although serial casting is less invasive than surgery, it still involves placing a patient's lower legs and feet in a series of plaster or fiberglass casts to continually stretch the muscles surrounding the ankle to prevent toe walking (Pistilli et al., 2014). The interior lining is waterproof, allowing individuals to bathe and additional rubber sole walking shoes with Velcro™ straps prevent slipping over the cast. Casting duration is typically 4–6 weeks (Ruzabarsky et al., 2016) with cast changes every 2 weeks, although some studies report casting duration of up to 10 weeks (Fox et al., 2006). Initial casts restrict ROM and require individuals to walk on their heels. This treatment precedes surgical interventions in typically developing individuals; however, individuals with ASD may be more likely to undergo surgery before attempting serial casting (Leyden et al., 2019). Serial casting is often the most effective non-surgical medical intervention (Bishop, 2016; Engström & Tedroff, 2012; Fox et al., 2006); however, long-term follow-up data are needed. In a review by van Bemmel et al. (2014), ITW returned in 52.1% of individuals at follow-up (M = 3.5 years).

Davies et al. (2018) conducted a retrospective study that examined the long-term effects of casting (n = 23) versus stretching (n = 20) in 43 participants ranging in ages 13–28 years. Follow-up exams were conducted approximately 13.4 years post-intervention (range = 9.4–17.8 years). All participants' casts were changed every 3 weeks during intervention. Following casting, 17 participants wore ankle foot orthoses (AFOs) for 1 year. Results showed a statistically significant difference in ITW from baseline to follow-up in the casting group but no significant difference in the stretching group. Seventy-four percent showed improvements, 26% were unchanged, and 52% of individuals self-reported ITW still occurred at follow-up. In the stretching group, 35% improved, 55% remained the same, and 10% worsened. Self-report data indicated persistent ITW for 45% participants at the follow-up exam. Unfortunately, long-term outcome data were obtained via the parent's verbal report and not verified with ROM. Thus, outcomes should be interpreted with caution. Other researchers have reported an insignificant advantage for casting over more conservative interventions (Stricker & Angulo, 1998).

Based on these inconsistent findings, Thielemann et al. (2019) extended gait analysis to include plantar heel force for 10 participants with ITW compared to a non-ITW control group. This prospective group design excluded participants with underlying neuromuscular medical conditions or those who received previous ITW interventions. Treatment consisted of serial casting, and casts were changed every 14 days. After the cast was removed, assessments were conducted at a 6-month follow-up visit. Results showed a significant reduction in gastrocnemius muscle stiffness and heel strike force. Treatment effects persisted during the follow-up exam. This study was the first to report that casting resulted in complete gait normalization compared to the control group. The generality of these treatment effects needs to be tested with other populations. Moreover, beyond 6 months, maintenance of treatment effects is unknown.

Botulinum Toxin A

Botulinum toxin A (BTX) is a neurotoxic protein that causes temporary paralysis at or near the injection site (Anwar & Zafar, 2013). Medical professionals inject BTX in the muscles to treat a variety of medical conditions (e.g., migraines, muscle stiffness, eye problems, cerebral palsy) and cosmetic enhancements (e.g., wrinkles, severe sweating). Treatment effects are temporary and dose-dependent, and last approximately 3 months (Anwar & Zafar, 2013; Jacks et al., 2004). Recently, BTX has been used to treat ITW.

Engström et al. (2010) evaluated the effects of BTX injections on ITW in 15 participants (5–13 years old) without ID. The researchers obtained gait analysis data during three different 10-m barefoot walks. Participants received BTX injections, 6 units/kg of body weight with a maximum of 400 units, into both calves at four different sites. The physical therapist instructed parents and participants to stretch five times per day and walk on heels for at least 50 steps a day. Gait analysis data indicated significant improvements during initial contact, in the swing phase, and in ROM with ankle dorsiflexion. Three of the 15 participants completely stopped toe walking, and parents reported favorable treatment outcomes.

Engström et al. (2013) conducted a randomized controlled parallel-group trial in Sweden with 47 participants that compared the effects of casting to casting plus BTX. Sixty-eight percent of participants reported a family history of ITW, and participants had no prior intervention history. Gait measures were obtained using a video analysis at the onset of the study, 3 weeks post-BTX injection, with post-treatment follow-up analysis at 3, 6, and 12 months. A maximum of 400 units of BTX was injected into the calf muscle in four areas. After BTX injections, participants were encouraged to stretch five times a week and walk on their heels 50 steps per day. A single BTX injection significantly decreased ITW and improved ROM for 11 of the 12 participants at the 12-month follow-up exam. The experimenters called the parents 3 to 5 years post-follow-up to track progress. Two parents reported ITW ceased, three parents indicated ITW occurred less than 50% of the time, two parents reported surgical interventions were necessary, and one parent stated ITW ceased after BTX plus casting. Only two parents reported ITW occurred 75–100% of the time. Three parents disclosed adverse outcomes that included moderate pain levels for 2–3 days post-injection.

In a similar study, Sätilä, et al. (2016) conducted a 2-year randomized control trial to evaluate the effects of BTX (N = 16) compared to a more conservative intervention (i.e., stretching, foot orthoses, or firm shoes) group (N = 14). Thirty participants (2–9 years old) presented with normal development and never received BTX, casting, or surgical interventions. The control group wore firm heel cups daily, night splints at least five nights per week, attended physical therapy once a week and stretched five times per week for at least 10 minutes per day. The BTX group received a 16 U/kg dose in three injection sites in both legs. Stretching occurred after the injections to activate the BTX. Experimenters evaluated ITW severity from videotapes of walking using a five-point scale. Follow-up assessments were conducted 6, 12, and 18 months. Interestingly, both groups showed significant improvements, and ITW was no longer present at the 24-month follow-up for 100% of the BTX group and 85% of the control group. Despite the less-than-clear conclusions of this study, other studies have also confirmed long-term BTX treatment effects, ranging from 6 months to 2 years when combined with other therapies (Brunt et al., 2004; Jacks et al., 2004).

Ankle Foot Orthoses (AFO)

AFO treatment trains individuals to walk with a proper heel-to-toe gait (Herrin & Geil, 2016). AFO can also provide additional muscle strengthening. Unfortunately, AFO are not intended for long-term use, and ITW often re-emerges shortly after removal. AFO restrict ROM and prevent ITW, whereas foot orthoses (FO), which end below the ankle, are less restrictive. Both AFO and FO are less invasive than other medical interventions, and some children's hospitals recommend AFO as the first line of defense against ITW (Herrin & Geil, 2016). Unfortunately, long-term outcomes are not promising.

Herrin and Geil (2016) conducted a randomized control trial to evaluate the effects of AFO (n = 10) compared to a FO (n = 9) on ITW in individuals without neurological conditions.

Participants ranged in age from 2 to 8 years. Experimenters obtained gait data using electronic motion analysis during five different 10 m walks. Participants in the AFO group demonstrated more significant treatment effects than the FO treatment group; however, treatment relapse occurred faster in the AFO group than in the FO group. That is, as soon as the AFOs were removed, ITW returned to baseline levels. Both parents and participants preferred the FO to the AFOs.

In addition to investigating AFO and FO, researchers have also examined FO with feedback. For example, Pollind and Soangra (2020) used customized insoles with two pressure points to provide vibration feedback to five participants with ITW between 9 and 17 years of age. All participants showed decreased ITW; however, absent vibration feedback, ITW returned for all participants.

Although AFO are a more conservative medical treatment, empirical research supporting treatment efficacy is limited. In addition, parents and medical providers should consider the limitations of AFO and FO before recommending them for treatment. Custom FO are expensive, and AFO are bulky, uncomfortable, and require special shoes. While wearing AFO, several studies reported participants experienced pressure sores (Berger et al., 2021). Furthermore, AFO are visually unappealing and can result in unpleasant social attention (e.g., bullying) (Ruzabarsky et al., 2016).

Watch and Wait

Finally, the most conservative medical treatment for ITW is watch and wait, which requires caregivers and medical professionals to simply monitor ITW over time. Engström and Tedroff (2012) surveyed 63 parents whose children met the criteria for ITW and did not have any other medical issues. Parents reported the approximate percentage of time (i.e., 25, 50, 75, 100%) their child was toe walking at various ages. Seventy-nine percent of parents reported that ITW stopped without treatment when their child was 10 years of age. In contrast, Stricker and Angelo (1998) indicated that 48 individuals with ITW made no significant improvements without treatment at a 3-year follow-up.

Overall, a variety of medical interventions have aided in the assessment and treatment of ITW. Surgical interventions and serial casting interventions have effectively reduced ITW; however, surgery is invasive, and a months-long recovery period is often necessary before the patient regains the ability to walk normally. While less invasive, serial casting prevents the patient from engaging in many everyday childhood activities, such as running and playing sports. Unfortunately for individuals with ASD, research suggests that ITW often returns after surgical interventions and serial casting in less than 2–3 years (Leyden et al., 2019). Therefore, researchers should examine ITW treatment relapse, especially for individuals with ASD and ID. Unfortunately, results from a health care survey (N = 908) reported a significant disconnect between medical professionals' understanding of common ITW treatments and a treatment consensus (Williams et al., 2020). The paucity of evidence-based treatments imposes additional treatment challenges, and non-evidence-based treatments need further examination. Recommending non-evidence-based treatments or treatments lacking for specific populations (i.e., ID, ASD) can impose tremendous financial burdens on families and the healthcare system (Williams et al., 2020).

Behavioral Assessment of ITW

Behavioral assessment of ITW first focuses on precisely defining ITW, as the specific topography ITW takes may vary across individuals. As described above, direct observation of ITW is the preferred method of measurement. However, the assessment of any given toe-walk response can be difficult for researchers to observe. Some toe walking responses may be easy to identify (e.g., when the heel remains several inches off the ground), whereas other responses may require a more subtle discrimination on the part of the observer. Once an operational definition is obtained, behavioral assessment focuses on measuring ITW.

After defining and beginning to measure ITW, behavioral assessment then turns to identifying the function or purpose of ITW. In contrast to medical assessment and intervention, which views ITW as a symptom of a biological abnormality, behavioral assessment involves an attempt to identify the purpose ITW serves. That is, if one wants to solve a challenging medical problem, it behooves the professional to get to the “root” of the problem. In the view of the medical profession, the root of the problem is often to be found in the biomechanics of toe walking. Thus, appropriate treatment involves a manipulation within the body or the use of a device which contacts the body (e.g., serial casting). From a behavioral perspective, however, it is possible that the “root” of most behavior, including ITW, is not found within the skin of the behaving organism. It is found, rather, within the functional relationship between the behaving organism and the environment. From this vantage, assessment must focus on identifying the environmental conditions which evoke and maintain ITW.

Functional assessment is the process behavior analysts use to identify the function of a behavioral excess (i.e., a behavior that is occurring too often). Four methods of functional assessment exist. Informant assessment involves obtaining information about the relationship between the behavioral excess and the environment through self or third-party report, often using questionnaires or surveys. Descriptive analysis involves directly observing the behavioral excess and recording the events that precede and follow it. Experimental or functional analysis involves directly manipulating environmental variables that may be relevant to the behavioral excess and noting how these variables affect the occurrence of the behavior. The AB method of functional analysis involves manipulating antecedents to the target behavior; the ABC method of functional analysis involves manipulating both antecedents and consequences to the target behavior.

In general, behavioral excesses such as toe walking serve one of the following functions: social positive reinforcement, social negative reinforcement, automatic positive reinforcement, and automatic negative reinforcement. Behavior maintained by social positive reinforcement is behavior that is strengthened by another person’s contingent delivery of stimuli. For example, the delivery of attention or preferred tangible items contingent upon aggressive behavior can strengthen and maintain aggression. Behavior maintained by social negative reinforcement is behavior that is strengthened by the contingent removal of stimuli by another person. As an example, the removal of demands or work requirements contingent upon property destruction can strengthen and maintain the property destruction. Behavior maintained by automatic positive reinforcement is behavior that is strengthened by the contingent production of a stimulus not mediated by another person. For example, the visual stimulation produced by moving your head from side to side while staring at a light can strengthen these head movements. Finally, behavior maintained by automatic negative reinforcement is behavior that is strengthened by the removal or termination of an unpleasant stimulus that is not mediated by another person. For example, massaging or rubbing your forehead might be strengthened because it alleviates a headache.

The few studies which have employed a functional assessment to identify the function of ITW have found that ITW is often maintained by automatic reinforcement (Hodges et al., 2018, 2019; Wilder et al., 2020, in press).

Although functional assessment of ITW has only been documented in a few studies to date (Hodges et al., 2018, 2019; Wilder et al., 2020, in press) future behavioral studies are likely to use functional assessment to identify the “root cause” of ITW. The field of behavioral assessment has emphasized the importance of a pre-treatment functional assessment for decades, and it has largely become standard practice.

Behavioral Interventions for ITW

Behavioral interventions for ITW have consisted of antecedent-based, reinforcement-based, and punishment-based procedures. Antecedent-based procedures have included the use of increased response effort (Hobbs et al., 1980) and a wristband to indicate when reinforcement is available (Hodges et al., 2018). Reinforcement-based procedures have included delivering conditioned reinforcement (Marcus et al., 2010) and differential reinforcement (Lancioni et al., 2013). Punishment-based procedures have included overcorrection (Barrett & Linn, 1981).

More recently, function-based interventions for ITW have been developed and evaluated. Function-based interventions are derived from the results of a functional assessment. As previously noted, the results of the functional assessments of ITW that have been conducted have indicated that ITW is often maintained by automatic reinforcement (Hodges et al., 2018, 2019; Wilder et al., 2020, in press). Unfortunately, behavioral excesses maintained by automatic reinforcement are not easy to treat. This is because it is often difficult to identify the specific source of stimulation produced by the target behavior (see Wilder et al. (in press) for a notable exception). In addition, even if the specific source of stimulation can be identified, behavioral interventions which target the source may not be practical. For example, few function-based treatment options exist for body rocking maintained by automatic reinforcement. Operant extinction, which involves severing the relationship between the response and the reinforcer, may not be feasible. Differential reinforcement procedures, which involve providing the reinforcer maintaining the target behavior for an alternative behavior or the absence of the target behavior, may be impossible.

Of course, non-function-based behavioral interventions have been evaluated to treat ITW as far back as the early 1980s. Hobbs et al. (1980) were the first to evaluate a behavioral intervention for ITW. Their participant was a young boy with a disability. These researchers first examined the use of a pair of heavy boots to increase the weight of each foot and therefore increase toe-to-heel steps. Next, they evaluated a differential reinforcement of other behavior (DRO) procedure. They conducted their treatment evaluation across two settings (hallways in a school and a playroom) and used a combination multiple baseline and withdrawal design. After the boots and DRO were assessed in isolation, the researchers examined the combination of these two procedures. The results suggest that the combination of the two procedures was more effective than either procedure alone. However, ITW still occurred during about 40% of intervals, even in the combined condition. Despite this, the researchers asked the participant's mother to use the combined intervention. They conducted a follow-up telephone call with the participant's mother more than 3 years after the conclusion of the study and noted that the mother reported no toe walking at that time. Of course, the researchers did not know what caused the dramatic decrease in ITW at follow-up and no formal follow-up data were presented. Finally, methodological flaws prevent firm conclusions regarding the effectiveness of the interventions.

This initial evaluation of a behavior analytic intervention for ITW is notable for a couple of reasons. First, the weighted boot intervention was rooted in response effort. That is, the effort required to engage in ITW with the boots on was likely quite high, and this may have been responsible for the effects of the boots. Second, the DRO procedure involved the delivery of food and tokens contingent upon the absence of ITW, but this appeared to be less effective than the weighted boots. However, as noted above, methodological (i.e., design) concerns prevent firm conclusions about the effects of the two procedures examined in this study.

A short time later, Barrett and Linn (1981) evaluated positive practice overcorrection to treat ITW exhibited by a 9-year-old boy with a moderate intellectual disability. Positive practice overcorrection is a punishment-based procedure in which, contingent upon engaging in the target behavior, the individual is required to perform the appropriate form of the behavior multiple times. In addition to overcorrection, these researchers evaluated a physical therapy procedure. The physical therapy involved four specific techniques focused on decreasing tendon rigidity and increasing ankle range of motion, both of which are relevant for ITW. These techniques were practiced across all phases of the study. The positive practice overcorrection procedure consisted of a verbal warning, which was followed by required toe tapping on cloth footprints for 30 seconds. When the participant tapped, the therapist held the participant's heel against the floor to be sure that he was practicing an appropriate step. At least 10 taps were required during each 30-second procedure. The therapist implemented this procedure contingent upon each instance of ITW. The procedure was effective and once ITW decreased, the researchers began implementing the verbal warning alone. If the participant stopped toe walking contingent upon the warning, the researchers did not implement the toe tapping procedure. During this phase, levels of ITW remained low. Finally, the researchers also conducted a follow-up phase during which they discontinued both the toe tapping procedure and the verbal warning. ITW maintained at low levels during this follow-up phase.

This study is also notable for a number of reasons. First, it is among the few studies to include a physical therapy procedure in addition to a behavioral intervention. Second, the researchers conducted an impressive follow-up evaluation, and the results were favorable. Finally, although the behavioral intervention was punishment-based, the researchers note that requiring the participant to repeatedly practice touching his toes to the ground while his heel was on the floor may have also contributed to learning the correct movements involved when walking appropriately. One limitation of the study is that the extent to which the physical therapy component was responsible for the treatment effects is unclear.

In a second study which examined the use of punishment to decrease ITW, Charlop et al. (1988) compared the effects of varied presentation of three punishers to the presentation of a single punisher to decrease problem behavior exhibited by three children with intellectual disabilities. One of the children, a 6-year-old girl, exhibited ITW; the other participants engaged in other topographies of problem behavior. The punishers in the varied punishment condition included a verbal reprimand, overcorrection, and a time-out procedure. The single punisher condition consisted of one of the three procedures above implemented in isolation. The results showed that varied presentation of punishers was more effective than any of the single presentation punishers to reduce ITW. However, because the researchers reported data across dependent variables, it is impossible to determine the specific effects of the procedures on ITW. These data suggest that, when a punishment procedure is used to reduce ITW, varied presentation of punishers may be more effective than the delivery of only one type of punishment procedure. Of course, non-punishment-based procedures should be evaluated before using a punishment-based intervention.

Marcus et al. (2010) were the first to use conditioned reinforcement to treat toe walking. Three children who engaged in ITW participated in their study. These researchers first paired squeaks produced by GaitSpot Auditory Squeakers™ with preferred items. They then affixed the Squakers to participants' shoes such that an appropriate heel-to-toe step produced an audible squeak, but an inappropriate toe step did not. They also attempted to fade the use of the squeakers. The procedure was effective; ITW by all participants decreased, although the degree of reduction varied by participant.

This study is interesting for a number of reasons. First, as described above, this study demonstrated the effective use of conditioned reinforcement. However, the authors also delivered reinforcement contingent upon each squeak when participants were wearing the squeakers on their shoes, so the contribution of the conditioned reinforcement is unclear. Second, the GaitSpot Squeakers™ enabled the researchers to measure ITW more easily. Instead of observing each step participants took, the researchers were able to measure the occurrence of ITW by listening for the sound of the squeaker. Third, the researchers also employed some techniques from simplified habit reversal (SHR), a behavioral intervention used to decrease other behaviors maintained by automatic reinforcement (Miltenberger et al., 1998). However, the exact way in which they incorporated SHR into their procedure was unclear. Despite its shortcomings, this study made two main contributions to the treatment of ITW: the use of conditioned reinforcement and increased ease of measurement.

Lancioni et al. (2012) used a technology-based differential reinforcement of alternative behavior (DRA) intervention to decrease toe walking by a woman with disabilities. These researchers used optic sensors and a digital music device to deliver preferred stimulation (music and recordings of praise from preferred staff members) to the woman contingent upon an appropriate heel-to-toe step. The procedure was effective; the participant increased her appropriate steps from less than 10% in baseline to more than 80% during the second phase of intervention implementation. Unfortunately, the researchers noted that the cost of this intervention was quite high due to the technology they employed. This cost may be prohibitive for many families.

In a follow-up study, Lancioni et al. (2013) used similar technology to provide flickering lights and vibration contingent upon each appropriate heel-to-toe step. The participant, a man with an ID, engaged in ITW. As in the first study, the researchers found that the participant's appropriate steps increased to 75–80% of all steps in the intervention phases of the study. The researchers did again note that the technology utilized in this study was expensive and may not be feasible to use with all children. Nevertheless, as this technology becomes more readily available, more individuals who engage in toe walking might benefit from its use.

Persicke et al. (2014) evaluated a novel intervention for ITW. These researchers examined the use of TAGteach™ to decrease toe walking exhibited by young boy with autism. TAGteach™, or teaching with acoustical guidance (TAG; TAGteach International, 2018), is a teaching technology that involves a therapist or teacher using a clicker to make an audible sound contingent upon a desired behavior (in this case, an appropriate step). The researchers began by pairing the clicker sound with a preferred food item. They then evaluated a correction procedure in the absence of the clicker. The correction procedure consisted of the therapist placing her hand on the participant's shoulder and applying gentle pressure contingent upon each step with toe walking. The correction procedure alone was ineffective, so the researchers then added the TAGteach™ procedure. In this phase, the researchers delivered a "click" sound contingent upon each appropriate step and used the correction procedure contingent upon every two steps with toe walking. The correction plus TAGteach™ procedure was effective; the percentage of appropriate steps increased to 80–90% during the final treatment phase, up from very low levels of appropriate steps in baseline.

The Persicke et al. (2014) study is notable for a couple of reasons. First, it was the first study to evaluate the use of the TAGteach™ method to increase a behavior exhibited by a child with autism. Second, as in Marcus et al. (2010), this study also used conditioned reinforcement to strengthen appropriate walking. However, instead of using squeakers attached to the participant's shoes, Persicke et al. used a clicker. Although this is creative, the squeaker or other device attached to a shoe may be more advantageous in that the audible sound is controlled directly by the participant's steps, whereas with TAGteach™ clicker training, the therapist must monitor walking and deliver a click when appropriate.

Hodges et al. (2018) evaluated a multiple schedule to decrease ITW exhibited a young boy with autism. A multiple schedule is a schedule of reinforcement in which a salient stimulus is correlated with one schedule of reinforcement, and the absence of the stimulus or another salient stimulus is correlated with another schedule of reinforcement. Hodges et al. used a wristband worn by the participant. The wristband indicated that reinforcement would be delivered for appropriate walking and reprimands would be delivered for toe walking. Initially, the participant wore the wristband infrequently, but the researchers systematically increased the duration of wristband wearing such that towards the end of the study, the participant wore the wristband nearly all of the time. Appropriate steps increased and toe walking decreased when the wristband was present, but toe walking was frequent in the absence of the wristband. The researchers implemented the procedure in both clinic and community settings, and taught the participant's mother to implement the procedure. Toe walking remained low, regardless of setting or implementer, as long as the wristband was in place. The researchers noted that the procedure has some advantages over other behavioral interventions in that it is relatively unintrusive.

Hirst et al. (2019) used a package behavioral intervention to decrease ITW exhibited by a typically developing 5-year-old girl. These researchers used differential reinforcement of other behavior (DRO), rules, and feedback in a package intervention. They first delivered an instruction to "walk flat footed" to the participant. The researchers then added a rule involving access to potential reinforcers contingent upon the absence of toe walking, and a DRO (access to preferred items contingent upon the absence of toe walking for specified time periods). Finally, they had the participant's teacher implement the package intervention. The package was effective; the percentage of intervals with ITW decreased substantially during intervention. This study was particularly notable because the participant did not have a disability. As described previously, although some typically developing children do exhibit toe walking, it is uncommon.

Hodges et al. (2019) replicated and extended Persicke et al. (2014) by using acoustical guidance to treat toe walking exhibited by a young boy with autism. These researchers first conducted a pre-treatment screening analysis in which they exposed the participant to a series of alone conditions used in a functional analysis (Querim et al., 2013). Toe walking persisted across the series, suggesting that ITW was maintained by automatic reinforcement. Next, the researchers paired the sound produced by an acoustical guidance device with the participant's preferred item. They then delivered the sound produced by the acoustical guidance device contingent upon each appropriate step. Finally, they thinned the delivery of the sound to a fixed-ratio 8 schedule and eventually discontinued it altogether. They ended by conducting a generalization probe in another setting. The acoustical guidance procedure was effective to increase appropriate steps and reduce ITW. This study is the first that included a functional assessment procedure to verify that ITW was maintained by automatic reinforcement.

Wilder et al. (2020) conducted functional assessments and treatment evaluations with three children who exhibited toe walking. Similar to Hodges et al. (2019), these researchers ran a series of pre-treatment alone conditions to verify that ITW was maintained by automatic reinforcement. The results showed that ITW occurred independent of social consequences. Next, the researchers replicated and extended Marcus et al. (2010) in that they used GaitSpot Auditory Squeakers™ to decrease toe walking. They first affixed the squeakers to participants' shoes before the squeakers had been paired with reinforcement, so that the squeakers provided auditory feedback, and the squeakers produced a sound contingent upon an appropriate heel-to-toe step. If necessary, the researchers then delivered participants' preferred edible items contingent upon squeaks / appropriate steps. They then thinned the schedule of edible delivery and evaluated the procedure in a different setting and when implemented by a different person. The results showed that for one participant, the squeak itself was sufficient to increase appropriate walking and decrease toe walking. For two other participants, edible items paired with the squeak were necessary to decrease ITW. This study is notable because of the inclusion of a pre-treatment assessment and because it included three participants, most evaluations of behavioral interventions for toe walking have included a single participant.

Most recently, Wilder et al. (in press) evaluated a function-based intervention for toe walking. These researchers noted that previous research has suggested that toe walking may vary by walking surface. That is, Fanchiang et al. (2016) suggested that some (e.g., rough) surfaces may inhibit toe walking, whereas other surfaces may encourage it. Building upon this, the researchers first conducted a functional analysis screening (Querim et al., 2013) to verify that toe walking exhibited by two young children with autism was maintained by automatic reinforcement. Next, they assessed toe walking on a variety of surfaces, including tile, artificial grass, and grip tape. Finally, they placed inserts of the surface associated with the lowest level of toe walking into each participants' shoes. The inserts were effective to substantially decrease toe walking by one participant and reduce toe walking to low levels for the second participant. To decrease the second participant's toe walking further, the researchers added a hand-on-shoulder procedure similar to the procedure used by Persicke et al. (2014).

Conclusions and Directions for Future Research

In conclusion, ITW is an ambulation disorder usually noticed in early childhood. Estimates suggest that as many as 20% of young children with ASD engage in ITW (Ming et al., 2007). In this chapter, we reviewed medical and behavioral approaches to assessment and treatment of ITW. Researchers have learned much about ITW, its assessment, and treatment over the last few decades, and these advances will contribute to more successful clinical outcomes. Nevertheless, there are some weaknesses of the existing literature on this topic.

Medical studies on ITW typically employ relatively large numbers of participants, which is a methodological strength of these studies. However, very few medical studies have employed random selection or random assignment of participants to control and treatment groups. Also, many medical studies employ questionable measures of ITW. That is, instead of directly observing and counting steps with toe walking, many medical studies have used parent or professional report of ITW. Finally, follow-up data on medical intervention effectiveness for ITW is deficient.

Behavioral research on ITW has typically employed one or a few subjects. Although single case research designs are typically used to evaluate the effects of an intervention at the individual level, replications of behavioral interventions with additional participants are needed to establish the generality of the procedures used. In addition, with few exceptions (e.g., Wilder et al., in press), behavioral interventions for ITW have not been function-based. Future research should focus on developing function-based procedures. Finally, like medical studies, evaluations of behavioral procedures need to examine the extent to which the procedures maintain over time.

One promising avenue for future research is collaboration across disciplines; very few studies have evaluated a combined medical and behavioral intervention for ITW. Another promising avenue is the development of an intervention hierarchy to guide patients and their families. This hierarchy should be based on intervention effectiveness as well as level of intervention intrusiveness and cost.

References

Accardo, P. J., & Barrow, W. (2015). Toe walking in autism: Further observations. *Journal of Child Neurology, 30*(5), 606–609. https://doi.org/10.1177/0883073814521298

Ali, E., Len, A., Ling, W., & Rao, S. (2020). Reliability of a new clinical gait assessment scale for children with idiopathic toe walking gait–A pilot study. *Physical & Occupational Therapy in Pediatrics, 40*(6), 669–680. https://doi.org/10.1080/01942638.2020.1744787

Alvarez, C., De Vera, M., Beauchamp, R., Ward, V., & Black, A. (2007). Classification of idiopathic toe walking based on gait analysis: Development and application of the ITW severity classification. *Gait & Posture, 26*(3), 428–435. https://doi.org/10.1016/j.gaitpost.2006.10.011

Anwar, M. S., & Zafar, H. (2013). Efficacy of botulinum toxin in benign essential Blepharospasm: Desirable & undesirable effects. *Pakistan Journal of Medical Sciences, 29*(6), 1389–1393. https://doi.org/10.12669/pjms.296.3853

Barrett, R. P., & Linn, D. M. (1981). Treatment of stereotyped toe walking with overcorrection and physical therapy. *Applied Research in Mental Retardation, 2*, 13–21. https://doi.org/10.1016/0270-3092(81)90003-5

Barrow, W. J., Jaworski, M., & Accardo, P. J. (2011). Persistent Toe Walking in Autism. *Journal of Child Neurology, 26*, 619–621. https://doi.org/10.1177/0883073810385344

Berger, N., Bauer, M., Hapfelmeier, A., Salzmann, M., & Prodinger, P. (2021). Orthotic treatment of idiopathic toe walking with a lower leg orthosis with circular subtalar blocking. *BMC Musculoskeletal Disorders, 22*, 520. https://doi.org/10.1186/s12891-021-04327-0

Bishop, C. (2016). Evaluation of pediatric toe walking. *Physician Assistant Clinic, 1*(4), 599–613. https://doi.org/10.1016/j.cpha.2016.05.00

Brunt, D., Woo, R., Kim, H. D., Ko, M. S., Senesac, C., & Li, S. (2004). Effect of botulinum toxin type A on gait of children who are idiopathic toe-walkers. *Journal of Surgical Orthopaedic Advances, 13*(3), 149.

Caserta, A., Pacey, V., Fahey, M., Gray, K., Engelbert, R., & Williams, C. (2019). Interventions for idiopathic toe walking. *Cochrane Database of Systematic Reviews, 10*, CD012363. https://doi.org/10.1002/14651858.CD012363.pub2

Charlop, M. H., Burgio, L. D., Iwata, B. A., & Ivancic, M. T. (1988). Stimulus variation as a means of enhancing punishment effects. *Journal of Applied Behavior Analysis, 21*(1), 89–95. https://doi.org/10.1901/jaba.1988.21-89

Cooper, J., Heron, T., & Heward, W. (2020). *Applied behavior analysis* (3rd ed.). Pearson.

Davies, K., Black, A., Hunt, M., & Holsti, L. (2018). Long-term gait outcomes following conservative management of idiopathic toe walking. *Gait & Posture, 62*, 214–219. https://doi.org/10.1016/j.gaitpost.2018.02.014

Engelbert, R., Gorter, J. W., Uiterwaal, C., van de Putte, E., & Helders, P. (2011). Idiopathic toe-walking in children, adolescents and young adults: A matter of local or generalised stiffness? *BMC Musculoskeletal Disorders, 12*, 61. https://doi.org/10.1186/1471-2474-12-61

Engström, P., & Tedroff, K. (2012). The prevalence and course of idiopathic toe-walking in 5-year-old children. *Pediatrics, 130*(2), 279–284. https://doi.org/10.1542/peds.2012-0225

Engström, P., Gutierrez-Farewik, E. M., Bartonek, Å., Tedroff, K., Orefelt, C., & Haglund-Åkerlind, Y. (2010). Does botulinum toxin A improve the walking pattern in children with idiopathic toe-walking? *Journal of Children's Orthopaedics, 4*(4), 301–308. https://doi.org/10.1007/s11832-010-0263-9

Engström, P., Bartonek, Å., Tedroff, K., Orefelt, C., Haglund-Åkerlind, Y., & Gutierrez-Farewik, E. M. (2013). Botulinum toxin A does not improve the results of cast treatment for idiopathic toe-walking: A randomized controlled trial. *Journal of Bone and Joint Surgery, 95*(5), 400–407. https://doi.org/10.2106/JBJS.L.00889

Fanchiang, H. D., Geil, M. D., Wu, J., Ajisafe, T., & Chen, Y. (2016). The effects of walking surface on the gait pattern of children with idiopathic toe walking. *Journal of Child Neurology, 3*, 858–863. https://doi.org/10.1177/0883073815624760

Fox, A., Deakin, S., Pettigrew, G., & Paton, R. (2006). Serial casting in the treatment of idiopathic toe-walkers and review of the literature. *Acta Orthopaedica Belgica, 72*(6), 722.

Hall, J. E., Salter, R. B., & Bhalla, S. K. (1967). Congenital short tendo calcaneus. *The Bone and Joint Journal, 49-B*(4), 695–697.

Hayes, K. B., Wimberly, R. L., VanPelt, J. M., Jo, C., Riccio, A., & Delgado, M. R. (2018). Toe walking: A neurological perspective after referral from pediatric orthopaedic surgeons. *Journal of Pediatric Orthopedics, 38*(3), 152–156. https://doi.org/10.1097/BPO.0000000000001115

Hemo, Y., Macdessi, S., Pierce, R., Aiona, M., & Sussman, M. (2006). Outcome of patients after achilles tendon lengthening for treatment of idiopathic toe walking. *Journal of Pediatric Orthopedics, 26*(3), 336–340. https://doi.org/10.1097/01.bpo.0000217743.44609.44

Herrin, K., & Geil, M. (2016). A comparison of orthoses in the treatment of idiopathic toe walking: A randomized controlled trial. *Prosthetics and Orthotics International, 40*(2), 262–269. https://doi.org/10.1177/0309364614564023

Hirst, E. S., Lockenour, F. M., & Allen, J. L. (2019). Decreasing toe walking with differential reinforcement of other behavior, verbal rules, and feedback. *Education and Treatment of Children, 42*(2), 185–199. https://doi.org/10.1353/etc.2019.0009

Hobbs, S. A., Altman, K., & Halldin, M. A. (1980). Modification of a child's deviant walking pattern: An alternative to surgery. *Journal of Behavior Therapy and Experimental Psychiatry, 11*, 227–229. https://doi.org/10.1016/0005-7916(80)90033-6

Hodges, A., Wilder, D., & Ertel, H. (2018). The use of a multiple schedule to decrease toe walking in a child with autism. *Behavioral Interventions, 33*(3), 1–8. https://doi.org/10.1002/bin.1528

Hodges, A., Betz, A., Wilder, D., & Anita, K. (2019). The use of contingent acoustical feedback to decrease toe walking in a child with autism. *Education and Treatment of Children*. https://doi.org/10.1353/etc.2019.0007

Jacks, L., Michels, D., Smith, B., Koman, L., & Shilt, J. (2004). Clinical usefulness of BTX-A in the lower extremity. *Foot and Ankle Clinics, 9*, 339–348. https://doi.org/10.1016/j.fcl.2004.01.003

Kim, S., Soangra, R., Grant-Beuttler, M., & Aminian, A. (2019). Wearable sensor-based gait classification in idiopathic toe walking adolescents. *Biomedical Sciences Instrumentation, 55*(2), 178.

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., La Martire, M. L., Oliva, D., & Groeneweg, J. (2012). Technology-based, pro-grams to promote walking fluency or improve foot-ground contact during walking: Two case studies of adults with multiple disabilities. *Research in Developmental Disabilities, 33*, 111–118. https://doi.org/10.1016/j.ridd.2011.08.029

Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., Alberti, G., Boccasini, A., Oliva, D., & Buono, S. (2013). Technology-based programs to improve walking behavior of persons with multiple disabilities: Two single-case studies. *Disability and Rehabilitation: Assistive Technology, 8*, 92–98. https://doi.org/10.3109/17483107.2012.678030

Leyden, J., Fung, L., & Frick, S. (2019). Autism and toe-walking: Are they related? Trends and treatment patterns between 2005 and 2016. *Journal of Children's Orthopaedics, 13*(4), 340–345. https://doi.org/10.1302/1863-2548.13.180160

Marcus, A., Sinnott, B., Bradley, S., & Grey, I. (2010). Treatment of idiopathic toe walking in children with autism using GaitSpot Auditory Speakers and simplified habit reversal. *Research in Autism Spectrum Disorders, 4*(2), 260–267. https://doi.org/10.1016/j.rasd.2009.09.012

Matthew, O., & Sean, P. (2012). Idiopathic toe walking. *Journal of the American Academy of Orthopaedic Surgeons, 20*, 292–300. https://doi.org/10.5435/JAAOS-20-05-292

McMulkin, M. L., Baird, G. O., Caskey, P. M., & Ferguson, R. L. (2006). Comprehensive outcomes of surgically treated idiopathic toe walkers. *Journal of Pediatric Orthopaedics, 26*(5), 606–611. https://doi.org/10.1097/01.bpo.0000230334.80910.0c

Michalitsis, J., Murphy, A. T., Rawicki, B., Haines, T. P., & Williams, C. (2019). Full length foot orthoses have an immediate treatment effect and modify gait of children with idiopathic toe walking. *Gait & Posture, 68*, 227–231. https://doi.org/10.1016/j.gaitpost.2018.11.022

Miltenberger, R. G., Fuqua, R. W., & Woods, D. W. (1998). Applying behavior analysis to clinical problems: Review and analysis of habit reversal. *Journal of Applied Behavior Analysis, 31*, 447–469. https://doi.org/10.1901/jaba.1998.31-447

Ming, X., Brimacombe, M., & Wagner, G. C. (2007). Prevalence of motor impairment in autism spectrum disorders. *Brain Development, 29*, 565–570. https://doi.org/10.1016/j.braindev.2007.03.002

Persicke, A., Jackson, M., & Adams, A. N. (2014). Brief Report: An evaluation of TAGteach components to decrease toe walking in a 4-year-old child with autism. *Journal of Autism and Developmental Disorders, 44*, 965. https://doi.org/10.1007/s10803-013-1934-4

Pistilli, E., Rice, T., Pergami, P., & Mandich, M. B. (2014). Non-invasive serial casting to treat idiopathic toe walking in an 18-month-old child. *NeuroRehabilitation, 34*, 215–220.

Pollind, M., & Soangra, R. (2020). Development and validation of wearable inertial sensor system for postural sway analysis. *Measurement, 165*(1), 108101. https://doi.org/10.1016/j.measurement.2020.108101

Pomarino, D., Ramírez Llamas, J., Martin, S., & Pomarino, A. (2017). Literature review of idiopathic toe walking: Etiology, prevalence, classification, and treatment. *Foot & Ankle Specialist, 10*(4), 337–342. https://doi.org/10.1177/1938640016687370

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Ortega, J. V., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis, 46*, 47–60. https://doi.org/10.1002/jaba.26

Ruzabarsky, J. J., Scher, D., & Dodwell, E. (2016). Toe walking: Causes, epidemiology, assessment, and treatment. *Current Opinion in Pediatrics, 28*(1), 40–46. https://doi.org/10.1097/MOP.0000000000000302

Sala, D. A., Shulman, L. H., Kennedy, R. F., Grant, A. D., & Chu, M. Y. (1999). Idiopathic toe- walking: A review. *Developmental Medicine & Child Neurology, 41*, 846–848. https://doi.org/10.1111/j.1469-8749.1999.tb00553.x

Sätilä, H., Beilmann, A., Olsén, P., Helander, H., Eskelinen, M., & Huhtala, H. (2016). Does botulinum toxin a treatment enhance the walking pattern in idiopathic toe-walking? *Neuropediatrics, 47*(03), 162–168. https://doi.org/10.1055/s-0036-1582138

Shetreat-Klein, M., Shinnar, S., & Rapin, I. (2014). Abnormalities of joint mobility and gait in children with autism spectrum disorders. *Brain and Development, 36*(2), 91–96. https://doi.org/10.1016/j.braindev.2012.02.005

Sobel, E., Caselli, M. A., & Velez, Z. (1997). Effect of persistent toe walking on ankle equinus: Analysis of 60 idiopathic toe walkers. *Journal of the American Podiatric Medical Association, 87*(1), 17–22. https://doi.org/10.7547/87507315-87-1-17

Stott, N. S., Walt, S. E., Lobb, G. A., Reynolds, N., & Nicol, R. O. (2004). Treatment for idiopathic toe-walking: Results at skeletal maturity. *Journal of Pediatric Orthopaedics, 24*(1), 63–69.

Stricker, S. J., & Angulo, J. C. (1998). Idiopathic toe walking: A comparison of treatment methods. *Journal of Pediatric Orthopedics, 18*(3), 289–293.

TAGteach International. (2018). Retrieved June 10, 2018 from http://www.tagteach.com/

Thielemann, F., Rockstroh, G., Mehrholz, J., & Druschel, C. (2019). Serial ankle casts for patients with idiopathic toe walking: Effects on functional gait parameters. *Journal of Children's Orthopaedics, 13*, 147–154. https://doi.org/10.1302/1863-2548.13.180183

Valagussa, G., Balatti, V., Trentin, L., Piscitelli, D., Yamagata, M., & Grossi, E. (2020). Relationship between tip-toe behavior and soleus-Gastrocnemius muscle lengths in individuals with autism spectrum disorders. *Journal of Orthopaedics, 21*, 444–448. https://doi.org/10.1016/j.jor.2020.08.013

Van Bemmel, A. F., Van de Graaf, V. A., Van den Bekerom, M., & Vergroesen, D. A. (2014). Outcome after conservative and operative treatment of children with idiopathic toe walking: A systematic review of literature. *Musculoskeletal Surgery, 98*, 87–93. https://doi.org/10.1007/s12306-013-0309-5

Wilder, D. A., Ertel, H., Hodges, A. C., Thomas, R., & Luong, N. (2020). The use of auditory feedback and edible reinforcement to decrease toe walking among children with autism. *Journal of Applied Behavior Analysis, 53*, 554–562. https://doi-org.portal.lib.fit.edu/10.1002/jaba.607

Wilder, D., Ingram, G., & Hodges, A. (in press). Evaluation of shoe inserts to reduce toe walking in young children with autism. *Behavioral Interventions*.

Williams, C., Tinley, P., & Curtin, M. (2011). The "Toe Walking Tool": A novel method of assessing toe walking children. *Journal of Foot and Ankle Research, 4*(S1), O51. http://www.jfootankleres.com/content/4/S1/O51

Williams, C. M., Gray, K., Davies, N., Barkocy, M., Fahey, M., Simmonds, J., Accardo, P., Eastwood, D., & Pacey, V. (2020). Exploring health professionals' understanding of evidence-based treatment for idiopathic toe walking. *Child: Care, Health, and Development, 46*, 310–319. https://doi.org/10.1111/cch.12745

19 Behavioral Assessment and Treatment of Feeding Problems in Autistic Children

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Contents

Introduction

Children with special needs are at higher risk for feeding problems than their typically developing peers. Feeding difficulties are estimated to occur in between 20% and 40% of typically developing children and up to 80% of children diagnosed with a developmental disability (Ahearn et al., 2001; Field et al., 2003; Ledford & Gast, 2006; Schreck et al., 2004). Although communication and social skill deficits are the most discussed characteristics of autism spectrum disorder, many

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of these children also have difficulty with daily living skills, such as toileting, dressing, and feeding. In fact, feeding difficulties occur in as many as 90% of autistic children (Kodak & Piazza, 2008; Schreck et al., 2004). Some researchers have even suggested the presence of feeding difficulties in infancy may be an early sign of autism (e.g., Keen, 2008; Laud et al., 2009; Twachtman-Reilly et al., 2008). Problems with mealtimes can be especially distressful for caregivers of autistic children. Although caregivers know the importance of their child eating a well-balanced diet, they often are unsuccessful in carrying this out because of the problems that occur during mealtimes. In fact, mealtimes with their children can become so difficult that many parents prepare separate meals for their children and avoid eating in restaurants or public settings. Some parents even go to great lengths to obtain specific food or drink items that their child will eat when the specific or similar items are discontinued or not easily accessible.

The most prevalent problem occurring in autistic children is selectivity by food type (i.e., consuming only a limited variety of foods) with reported prevalence rates up to 72% (Ahearn et al., 2001; Bandini et al., 2010; Field et al., 2003; Schreck & Williams, 2006; Twachtman-Reilly et al., 2008). It is not uncommon for toddlers and young children to refuse their peas and carrots. "Picky eating" in which a child refuses more than just vegetables is also not uncommon in childhood but often resolves over time without intervention. However, children with a disordered pattern of eating in the form of selectivity by food type eat a severely restricted diet (often less than 20 foods) requiring intervention (Curtin et al., 2015; DeMand et al., 2015; Schreck et al., 2004). Some children may refuse all foods in one or more food groups. Some children may refuse foods or drinks that they typically consume if an alternative brand or variation is offered, if the foods or drinks differ in temperature or appearance (e.g., discolored, broken, or cut), or if the foods or drinks are presented with different utensils. Another common problem among autistic children is food selectivity by texture. For example, some children may only consume purees or smooth foods (e.g., yogurt or applesauce) or crunchy foods (e.g., chips, crackers, and cookies). Often, the feeding difficulties of an autistic child involve some combination of these concerns.

These concerns are not surprising given that inflexible, restrictive, or repetitive patterns of behavior and often an insistence on sameness are characteristic of autism spectrum disorder (Ahearn et al., 2001; American Psychiatric Association [APA], 2013; Crowley et al., 2020). However, some autistic children exhibit a wider range of feeding difficulties including total food refusal, adipsia (refusal of liquids), liquid dependence, and delayed self-feeding skills. Food selectivity is often mistakenly conceptualized as being "less severe" than these other feeding difficulties. Based on our clinical experience, food selectivity can be as or more challenging as food refusal, adipsia, or liquid dependence to effectively and thoroughly treat. This may be due in part to a child's behavior being more resistant to change than that of a child with no or limited feeding history.

Children with feeding difficulties often exhibit inappropriate mealtime behavior (e.g., turning away from or pushing the food away or covering the mouth), negative vocalizations (e.g., crying or negative statements), expulsions (i.e., food coming out of the mouth forcefully or passively), and packing (i.e., food remaining in the mouth). Caregivers may inadvertently reinforce these behaviors by providing escape (by ending the meal, removing nonpreferred food items, or delaying bite presentations); attention (in the form of coaxing, comforting, or reprimanding); and/or highly preferred food or toys. These continued interactions between a child and their caregiver may contribute to the maintenance of these problem behaviors.

However, feeding difficulties exhibited by autistic children should *not* be conceptualized as just an additional area of noncompliance. When an individual exhibits a feeding disturbance that is characterized by significant weight loss or failure to achieve expected weight gain, significant nutritional deficiency, dependence on enteral feedings or oral nutritional supplements, and/or interference with psychosocial functioning, they meet criteria for either avoidant/restrictive food intake disorder (ARFID; APA, 2013) or a pediatric feeding disorder (World Health Organization, 2019). Recent clarification of these diagnoses highlights best practices to treat feeding difficulties exhibited by autistic individuals. That is, the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; APA, 2013) diagnosis of ARFID replaced the Diagnostic and Statistical Manual of Mental Disorders-IV diagnosis of feeding disorder of infancy or early childhood. This change was driven by the desire to better represent the needs of patients with an eating disorder, not otherwise specified and common comorbidities of mental health disorders, with anxiety disorders being the most common (Kennedy et al., 2018). In these cases, treatment primarily provided by mental health providers is appropriate. Whereas common comorbidities of a pediatric feeding disorder, as described more recently by the World Health Organization's International Classification of Diseases and Related Health Problems (11th ed.; 2019), include medical problems and/or developmental disability; and, multidisciplinary care across four core domains (medical, nutrition, feeding skill, and psychosocial) represents the standard of care (Sharp et al., 2022).

Approximately 86% of children with feeding difficulties have a diagnosed medical disorder (Rommel et al., 2003). Common associated medical problems include gastrointestinal disorders (e.g., gastroesophageal reflux disease and eosinophilic esophagitis), food allergies and intolerances, and anatomical anomalies (Field et al., 2003; Piazza, 2008). Researchers have found mixed results on whether gastrointestinal symptoms occur more frequently in neurodivergent children than neurotypical children (e.g., Chaidez et al., 2014; Erickson et al., 2005; Kerwin et al., 2005; Levy et al., 2007; Valicenti-McDermott et al., 2006). However, the most prevalent medical diagnoses associated with feeding difficulties are gastroesophageal reflux disease and constipation (Ibrahim et al., 2008; Rommel et al., 2003). It is common for autistic children exhibiting food selectivity by type to consume a diet that excludes vitamin- and fiber-rich foods and to consume less than their recommended fluid needs (Ahearn et al., 2001; Barnhill et al., 2018; Esteban-Figuerola et al., 2019; Schreck et al., 2004). Thus, it is not surprising for constipation to be a common concern in these cases.

Approximately 61% of children with feeding difficulties have existing oral-motor skill deficits (Rommel et al., 2003). Eating is a complex chain of behaviors that includes accepting food or liquid, forming a bolus before lateralizing solid food to the back molars, chewing until the food is adequately masticated, re-forming a masticated bolus, propelling the bolus back, swallowing, and retaining the food or liquid (Arvedson & Brodsky, 2002). Although this chain of behaviors comes naturally for most children, difficulties can arise at any point in the chain for some children. Oral motor deficits that contribute to feeding difficulties may include problems with lip closure, tongue movement, chewing, or swallowing (dysphagia) and structural impairments (Field et al., 2003). When a child is dependent on liquids or enteral feedings for the majority or all their nutrition, they may miss opportunities to develop the skills needed to successfully chew and swallow, delaying the development of important oral-motor skills. A common misconception is that when a child consumes at least some table texture foods, they have sufficient oral-motor skills. However, just because a child consumes table texture foods does not mean that their chewing patterns are well-developed, that they adequately masticate food for safe and appropriate swallowing, or that the child is a safe oral-feeder.

The role of co-occurring medial conditions and oral-motor skill delays and deficits must be considered during assessment and throughout the treatment of feeding difficulties. These factors often contribute to eating becoming aversive as it may be either painful or difficult to complete the chain of behaviors associated with eating (Babbitt et al., 1994; Bachmeyer, 2009; Field et al., 2003; Piazza, 2008), and if left unaddressed, behavioral interventions may be less effective or worsen the feeding difficulties.

Safe and effective intervention is warranted when a child exhibits chronic feeding difficulties, as they may be at risk for numerous negative consequences, including additional medical problems (e.g., malnutrition, dehydration, obesity), cognitive and developmental problems, and social concerns (e.g., social stigma, missed opportunities to develop social interactions). Additionally, caregivers of children with chronic feeding difficulties may experience increased levels of stress, placing them at a higher risk for mental health difficulties (Franklin & Rodger, 2003; Greer et al., 2008).

Interdisciplinary Approach

Due to the often-complex etiology of feeding difficulties, an interdisciplinary approach is important to identify or rule out all possible factors that may be contributing to the feeding problems prior to and throughout treatment (Miller et al., 2001; Piazza, 2008). An interdisciplinary approach consists of collaborative care between a medical provider with expertise in pediatric gastroenterology, a pediatric dietician, an oral-motor specialist (speech language pathologist or occupational therapist), and a behavior analyst or psychologist. Each discipline brings a specific area of expertise to the team, and each member should have specialized training in the treatment of feeding difficulties.

The medical provider completes a physical exam and reviews current symptoms and medical, developmental, and feeding histories to determine if medical treatment or testing is necessary to clear the child to begin feeding therapy. They monitor the child's medical status and make changes to the medical recommendations throughout therapy as necessary. Without collaborative care with an appropriate medical provider before and throughout treatment, medical factors contributing to feeding difficulties may be overlooked as behavioral noncompliance, and behavioral intervention may exacerbate medical conditions and the feeding difficulties. It is important to note that the behavior analyst should not simply refer a child for medical testing (e.g., a swallow study or abdominal x-ray) because they have feeding difficulties or are not progressing with behavioral intervention. These tests may unnecessarily expose the child to radiation or in some cases make the feeding aversion worse. Therefore, the appropriate provider needs to determine when medical testing is needed, taking into consideration these factors and the child's medical status and feeding difficulties.

The registered dietician evaluates the child's nutritional intake and growth parameters. They analyze daily food logs and medication regimens to determine how many calories the child consumes daily on average and if there are any nutritional excesses or deficits. The dietician then provides recommendations for foods, liquids, and supplements that should be targeted during treatment with the aim to meet the child's nutritional needs. They continuously monitor the child's growth and nutritional status throughout treatment and modify their recommendations as necessary to guide the goals of behavioral intervention. The medical provider and dietician often coordinate specific recommendations.

The oral-motor specialist completes an oral motor assessment to identify any skill deficits (e.g., delayed chewing or tongue lateralization), structural abnormalities, and safety concerns or risks (e.g., aspiration or difficulty swallowing) before behavioral intervention begins. The oral-motor specialist may refer the child for additional testing such as a modified barium swallow study if necessary. They may provide additional recommendations for appropriate food textures, liquid consistency, bolus sizes, and feeding apparatuses based on the child's current skill level and anatomy. They also create a plan for the developmental of oral-motor skills in a systematic manner.

The behavior analyst or psychologist conducts assessments to identify the effects of environmental variables on the child's feeding behavior. The behavior analyst should coordinate assessments with the oral-motor specialist to understand how the child's oral-motor skills are interacting with environmental variables to influence their feeding behavior. The behavior analyst designs and evaluates individualized empirically supported treatments to increase adaptive behaviors (e.g., accepting, chewing, and swallowing bites) and decrease problem behaviors (e.g., inappropriate mealtime behavior, expulsion, and packing).

Behavioral Assessment

Descriptive Analysis of Inappropriate Mealtime Behavior

A descriptive analysis of inappropriate mealtime behavior involves observing a natural unstructured meal to identify antecedent variables and caregiver-delivered consequences (e.g., Borrero et al., 2010, 2016). For example, Borrero et al. (2010) conducted descriptive analyses of inappropriate mealtime behavior exhibited by children within 25 parent-child dyads. They compared the conditional probability of common caregiver-delivered consequences (i.e., escape, attention, and/or tangible items) to determine if caregivers were more likely to deliver these consequences following instances of inappropriate mealtime behavior. Results showed that caregivers were more likely to provide specific consequences following inappropriate mealtime behavior, suggesting that those caregiver-delivered consequences may be maintaining their child's problem behavior. Descriptive analyses provide opportunities for the interdisciplinary team to observe meals under naturalistic conditions. These observations may also indicate that the child may need further medical evaluation, specific food or food texture manipulations, or a combination of these prior to conducting additional assessment or treatment. However. descriptive analyses only identify a correlational relationship between the child's problem behavior and environmental variables; and therefore, we can only assume that the relations are functional.

Functional Analysis of Inappropriate Mealtime Behavior

A functional analysis involves the systematic manipulation of antecedents and consequences to identify reinforcers maintaining problem behavior (Iwata et al., 1982/1994). A few researchers have developed functional analysis methodologies to identify reinforcers maintaining inappropriate mealtime behavior (Girolami & Scotti, 2001; Najdowski et al., 2008; Piazza et al., 2003a). For example, Piazza et al. (2003a) used procedures similar to those described by Iwata et al. (1982/1994) to conduct functional analyses of the inappropriate mealtime behavior exhibited by 15 children with feeding difficulties. The researchers conducted a control condition and three test conditions (i.e., escape, attention, and tangible). The feeder provided access to highly preferred toys and interacted with the child throughout the session during the control condition. No differential consequences were delivered if the child engaged in inappropriate mealtime behavior and the bite or drink remained at midline. During each test condition, the feeder delivered a specific consequence following inappropriate mealtime behavior. The feeder removed the bite or drink in the escape condition, provided attention in the attention condition, and delivered a preferred toy or preferred food in the tangible condition. Of the 10 children who showed differential responding, 90% exhibited behavior maintained by escape, 80% by attention, and 20% by tangible items. Although 80% of those children displayed behavior that was multiply controlled, not all children's problem behavior was maintained by the same or all functions.

A functional analysis precisely identifies the functions that are maintaining problem behavior, which may lead to the most specific, effective, and efficient treatment. Bachmeyer et al. (2009) and Kirkwood et al. (2020) showed that it may be necessary to treat all functions when inappropriate mealtime behavior is multiply controlled. For example, Bachmeyer et al. (2009) examined the effects of extinction procedures matched individually and in combination to inappropriate mealtime behavior maintained by both escape and attention for 4 children with feeding disorders. Results indicated that attention extinction alone did not result in increased acceptance or decreased inappropriate mealtime behavior. Although escape extinction alone resulted in increased levels of acceptance and decreased rates of inappropriate mealtime behavior, inappropriate mealtime behavior did not decrease to clinically acceptable levels until escape extinction and attention extinction were implemented simultaneously. Whereas Kirkwood et al. (2021) found that it was unnecessary to withhold attention following inappropriate mealtime behavior maintained only by escape when comparing the effects of escape extinction when the feeder provided and withheld attention for 3 children. These results suggest that although clinicians often train caregivers to use healthy contingencies, it may not be necessary to treat all potential functions of inappropriate mealtime behavior. This is important because including unnecessary treatment components may result in less efficient treatment and caregiver training. Further, training a caregiver to withhold attention, such as reprimands following problem behavior when the child's inappropriate mealtime behavior is not maintained by attention, when their child's behavior is generally governed by rules may eliminate a previously effective strategy for the caregiver. Moreover, teaching caregivers to implement an unnecessary procedure may increase complexity and negatively impact procedural integrity (Fisher et al., 2016; Vollmer et al., 2008).

Antecedent Assessments

Some children are more willing to accept some foods or drinks under specific conditions. An assessment(s) manipulating antecedent variables (e.g., food type or texture, bite size, utensil) may identify such conditions by accommodating skill deficits and/or altering the efficacy of reinforcers maintaining inappropriate mealtime behavior (e.g., Kerwin et al., 1995; Konst et al., 2017; Patel et al., 2002b, 2005; Sharp & Jaquess, 2009). One method is to alter the antecedent conditions while keeping consequences for inappropriate mealtime behavior consistent (Smith & Iwata, 1997). Determining antecedent conditions under which the individual accepts and consumes some foods or drinks may assist in identifying the best conditions under which to initiate treatment, and the relevant antecedent variables can be gradually changed throughout treatment to meet goals and achieve age-typical eating. This becomes particularly important when a child has skill deficits, and that additional treatment components may be needed to teach specific skills as the antecedent conditions are changed.

Evaluations of food type or texture may result in the identification of specific foods or textures that are associated with different levels of problem behavior, acceptance, or consumption (Konst et al., 2017; Munk & Repp, 1994; Patel et al., 2002a, b, 2005; Sharp & Jaquess, 2009). For example, Patel et al. (2005) conducted food texture assessments with 3 children diagnosed with developmental disabilities who exhibited overall inadequate intake. Results showed that packing decreased and consumption increased with lower textured foods compared to higher textured foods for all 3 children. Similarly, Konst et al. (2017) assessed the interactive effects of varying viscosities of high- and low-preferred pureed foods on bite acceptance with lip closure around the spoon for an autistic child. Results indicated increased acceptance with appropriate lip closure with foods that were relatively more preferred and at a lower viscosity.

Varying bite sizes in isolation or in combination with other antecedent variables (e.g., food type and/or texture) may also result in differential responding. For example, Sharp and Jaquess (2009) assessed bite size and food texture to prescribe treatment for an autistic child with food selectivity. Smaller bite sizes resulted in decreased inappropriate mealtime behavior, and lower food textures resulted in decreased gagging and increased consumption.

Presenting food or drink using specific utensils may also result in differential responding. In some cases, specific stimuli (e.g., plates, cups, utensils) are highly preferred, and in other cases, certain utensils may accommodate skill deficits. For example, Sharp et al. (2010) compared rates of expulsion and levels of mouth clean across three bite-presentation methods (upright spoon, flipped spoon, and NUK brush) in the absence of bite re-presentation. Results showed lower rates of expulsion and higher levels of mouth clean during the flipped spoon and NUK brush presentations compared to the upright spoon.

Behavioral Treatment

A few researchers have reviewed the literature for behavior analytic studies targeting feeding problems in autistic children and noted that research studies addressing feeding problems in this specific population are limited relative to the broader literature including other pediatric populations (Ledford & Gast, 2006; Volkert & Vaz, 2010). It is possible that effective interventions for other populations may not generalize to autistic children due to their unique cognitive and behavioral profiles. However, research has shown that behavior-analytic strategies are effective at increasing appropriate behavior and decreasing inappropriate behavior with autistic children (Kodak & Piazza, 2008). Therefore, it is reasonable to assume behavior analytic strategies effective at treating feeding problems in other pediatric populations would also be effective at treating feeding problems in autistic children. Regardless, research studies targeting other populations can provide a foundation for clinical application and research to treat feeding problems in autistic children.

A few researchers have specifically evaluated treatment outcomes applying procedures documented in the extant literature exclusively with autistic participant groups (Laud et al., 2009; Sharp et al., 2011). For example, Laud et al. (2009) showed improvement in feeding behaviors for 46 autistic children admitted to an interdisciplinary feeding program, which included behavior-analytic interventions. Sharp et al. (2011) showed improved mealtime performance in 13 autistic children using a behavioral treatment package (i.e., escape extinction, reinforcement, and stimulus fading procedures).

Given that feeding consists of a chain of individual responses (e.g., acceptance, lateralization, chewing, swallowing), it is not surprising that most interventions include multiple treatment components to target specific topographies of appropriate or maladaptive feeding behaviors or assist in specific skill development. In this section, we provide a brief discussion of empirically supported treatment components to address specific topographies of appropriate and inappropriate feeding behaviors.

Increasing Acceptance and Decreasing Inappropriate Mealtime Behavior

Researchers have shown that escape is the most common environmental variable maintaining inappropriate mealtime behavior (Bachmeyer et al., 2009; Piazza et al., 2003b). Thus, it is not surprising that escape extinction procedures are commonly used in the treatment of feeding disorders (e.g., Ahearn 2002; Bachmeyer et al., 2009; Najdoswki et al., 2003; Piazza et al., 2003b; Reed et al., 2004). Nonremoval of the spoon involves keeping the utensil at the child's lips until the child actively accepts the bite or drink or until the feeder has an opportunity to safely deposit it (Hoch et al., 1994). The feeder follows the child's head if they turn away and blocks the child's attempts to push away the food, utensil, or feeder's hand or arm. The child learns that inappropriate mealtime behavior no longer results in escape from presentation of bites or drinks. Physical guidance involves guiding the mouth open by applying light pressure to the mandibular joint if the child does not actively accept the bite (Ahearn et al., 1996). The effectiveness of escape extinction has been well-documented, and it is the most widely reported procedure within the pediatric feeding disorder literature (Volkert & Piazza, 2012). However, escape extinction procedures should only be implemented with careful consideration for the child's safety and by well-trained individuals.

Other forms of function-based extinction procedures are often necessary, such as attention extinction and tangible extinction. For example, Bachmeyer et al. (2009) examined extinction procedures individually and in combination with four children whose inappropriate mealtime behavior was maintained by both escape and attention. Results showed that inappropriate mealtime behavior did not decrease to clinically acceptable rates until escape extinction and attention extinction were implemented simultaneously.

Escape extinction is often implemented in combination with reinforcement procedures (e.g., Allison et al., 2012; Berth et al., 2019; Freeman & Piazza, 1998; Piazza et al., 2003b; Reed et al., 2004). Differential reinforcement of alternative behavior (DRA) involves providing reinforcement in the form of praise, attention, playing, and access to preferred toys and/or edible items contingent on appropriate mealtime behavior (i.e., acceptance, mouth clean). Noncontingent reinforcement (NCR) involves the feeder providing attention, plays, and provides access to a preferred toy and/or edible item on a continuous or time-based schedule. Some researchers have found that all escape extinction may be necessary to decrease inappropriate mealtime behavior and increase acceptance; the addition of positive reinforcement results in beneficial effects, such as the absence of an extinction burst and/or overall decreased inappropriate mealtime behavior or negative vocalization for some children (e.g., Berth et al., 2019; Piazza et al., 2003b; Reed et al., 2004). For example, Piazza et al. (2003b) showed that acceptance did not increase following the implementation of DRA alone and only increased to clinically acceptable levels after escape extinction was implemented, regardless of the presence or absence of DRA. However, the addition of DRA to escape extinction had beneficial effects for some children (e.g., no extinction bursts, decreased inappropriate mealtime behavior and negative vocalizations). Similarly, Reed et al. (2004) showed that acceptance increased only when escape extinction was implemented, regardless of whether NCR was included, but NCR had beneficial effects for some children.

Some researchers have shown that reinforcement procedures alone can increase acceptance and decrease inappropriate mealtime behavior for some children (e.g., Berth et al., 2019; Brown et al., 2002; Levin & Carr, 2001; Riordan et al., 1984; Wilder et al., 2005). Considerations for increasing the effectiveness of reinforcement procedures include deprivation, quality, immediacy, and consistency of the reinforcer. For example, Levin and Carr (2001) examined the effects of food satiation on continent access to preferred foods to increase consumption of nonpreferred foods with four autistic children. Consumption was highest with the positive reinforcement contingency and when access to the preferred was limited before meals. Cooper et al. (1999) showed that higher consumption was associated with greater reinforcement quality (i.e., number of reinforcers) in the absence of escape extinction with a child with poor growth.

Antecedent-Based Procedures

There is a growing body of literature demonstrating the effectiveness of antecedent-based procedures that provide alternatives to or mitigate the side effects of escape extinction procedures or that enhance the effectiveness of reinforcement or escape extinction procedures. Antecedent-based procedures involve modifying variables that alter the aversive properties of the mealtime and/or food or drink presentations and the efficacy of the reinforcers that maintain problem behavior (Michael, 1993). Procedures with the most empirical support include demand fading, simultaneous presentation, stimulus fading, and a high-probability instructional sequence.

Demand fading involves gradually increasing the requirement for reinforcement and has included fading across the size or number of bites (e.g., Sharp & Jaquess, 2009; Riordan et al., 1980). For example, Riordan et al. (1980) increased the number of bites required for reinforcement for two children exhibiting persistently low and highly selective food intake, one with developmental disabilities. Results showed that consumption rate increased, food expulsion decreased, gram intake increased, and weight gain occurred all in the absence of escape extinction.

Simultaneous presentation involves presenting a more preferred food with a less preferred food (e.g., Ahearn, 2003; Kern & Marder, 1996;

Piazza et al., 2002). Piazza et al. (2002) compared simultaneous presentation of preferred and nonpreferred foods to sequential presentation (contingent access to preferred foods) to treat the food selectivity of three children. Results showed that simultaneous presentation was more effective than sequential presentation for all three children, and simultaneous presentation was effective in the absence of escape extinction for two children. Consumption increased only in the simultaneous presentation condition and not in the sequential presentation condition when escape extinction was added for the third child. Ahearn (2003) added condiments to increase the acceptance of three previously rejected food items in the absence of reinforcement and escape extinction for an autistic child. After acceptance of target foods increases with simultaneous presentation, stimulus fading is often used to gradually decrease the amount of preferred food and increase the amount of target food (Patel et al., 2001).

Stimulus fading involves gradually changing the ration or concentration of preferred and nonpreferred food or drinks, food texture or viscosity, or feeding apparatus (e.g., Bachmeyer et al. 2013; Groff et al., 2011; Johnson & Babbitt, 1993; Luiselli et al., 2005; Mueller et al., 2004; Tiger & Hanley, 2006). For example, Luiselli et al. (2005) successfully used stimulus fading in the absence of escape extinction to increase milk consumption in an autistic child by gradually fading whole milk (a nonpreferred drink) into Pediasure (a preferred drink). Mueller et al. (2004) blended nonpreferred foods into preferred foods in various ratios (e.g., 20% nonpreferred/80% preferred) to increase consumption of nonpreferred foods with two children. Bachmeyer et al. (2013) gradually altered the concentration of a liquid (i.e., a consistently consumed stimulus) by adding baby food to the liquid to increase baby food consumption in two children, one with developmental delays. Groff et al. (2011) increased liquid consumption from a cup in a child who consumed solids and liquids from a spoon by using spoon-to-cup fading.

A high-probability (high-*p*) instructional sequence involves delivering a series of instructions that a child is likely to comply with (high-*p*), such as accepting an empty spoon or highly preferred food followed by an instruction that a child is unlikely to comply with (low-*p*), such as accepting or swallowing a nonpreferred bite or drink (e.g., Dawson et al., 2003; Ewry & Fryling, 2016; Patel et al., 2006, 2007; Penrod et al., 2012). The high-*p* sequence may be effective without escape extinction for some children. For example, Patel et al. (2007) used a high-*p* sequence (i.e., three presentations of an empty spoon) to increase compliance with a low-*p* response (i.e., consumption of a nonpreferred food) in the absence of escape extinction with an autistic child. Ewry and Frlying (2016) used a topographically similar high-*p* sequence (i.e., bites of food) to increase compliance with a low-*p* response (i.e., target foods) in the absence of escape extinction procedures with an autistic child.

Expulsion

Expulsion occurs when a previously accepted bite or drink crosses the plane of the lips and exits the mouth. Expulsion may increase after inappropriate mealtime behavior and acceptance are treated and is often conceptualized as a shift in response topography when escape extinction contingencies are present. That is, the child learns to accept the bite but expels to escape or avoid the food or drink (e.g., spitting out the bite forcefully, wiping out of the mouth). In other cases, oral-motor skill deficits may result in difficulty handling and manipulating the food or liquid and passive expulsion occurs (i.e., food or liquid runs or falls out of mouth; Patel et al., 2005). Persistent expulsion can lead to decreased intake and increased mealtime durations (Wilkins et al., 2011).

The most common treatment for expulsion is re-presentation, which occurs when the feeder scoops up the expelled food or liquid or gets a new bite or drink of the same food with a spoon or NUK brush and places it back into the child's mouth (Coe et al., 1997; Sevin et al., 2002; Shalev et al., 2018; Sharp et al., 2012). Re-presentation can be conceptualized as an escape extinction procedure by minimizing escape or avoidance from the food, and it is often used in combination with other escape extinction procedures, such as nonremoval of the spoon (e.g., Coe et al., 1997; Girolami et al., 2007; Patel et al., 2002a, b; Sevin et al., 2002). Girolami et al. (2007) compared re-distribution procedures with a spoon and NUK brush with one child. Results indicated that fewer expulsions occurred when a NUK brush was used to re-present purees compared to a spoon and when the initial and re-presented bites were presented on a NUK brush.

Another common treatment for expulsion is a chin prompt (Dempsey et al., 2011; Shalev et al., 2018; Wilkins et al., 2011). A chin prompt occurs when the feeder places their forefinger under the child's chin during presentation, places their thumb under the child's lower lip after the food or liquid enters the mouth, and applies gentle upward pressure on the child's chin with the forefinger and the child's lower lip with the thumb (Wilkins et al., 2011). Chin prompts are hypothesized to be effective in the treatment of expulsion because they facilitate mouth closure, which may reduce the effort of swallowing and increase the effort for expulsion and may help to address oral-motor deficits by associating the upward movement of the jaw with mouth closure and swallowing (Ibañez et al., 2021; Wilkins et al., 2011).

When re-presentation alone was ineffective at decreasing expulsion in four children with feeding difficulties, Wilkins et al. (2011) added a chin prompt and observed a decrease in expulsion across solids and liquids for all children, one of which was diagnosed with a developmental delay. Ibañez et al. (2021) compared re-presentation and a modified chin prompt (i.e., the feeder placed the pads of their index and middle fingers under the child's chin and their thumb under the child's bottom lip, deposited the drink only when the child's jaw muscles were relaxed, and exerted gentle, upward pressure on the child's chin during the deposit) to treat expulsion in three autistic children. Ibañez et al. found that expulsion decreased to clinically meaningful levels with either a modified chin prompt or re-presentation for one child, only with re-presentation for the second child, and with a modified chin prompt plus re-presentation for the third child. Shalev et al. (2018) compared the effects of a modified chin prompt versus reclined seating on liquid expulsion of two children, one of which was autistic. Results indicated decreased levels of expulsion for both children when a modified chin prompt or reclined seating was added to nonremoval of the cup, re-presentation, and differential reinforcement for acceptance.

The role of food texture and consistency is important to consider in the treatment of expulsion given the prevalence of autistic children who exhibit food selectivity by texture and have trouble progressing to higher textures (Ahearn et al., 2001; Aponte & Romanczyk, 2016). Patel, Piazza et al. (2002a, b) found that altering the food type (i.e., removing meats) and food texture (i.e., decreasing to a smoother texture) resulted in less expulsion when re-presentation with a NUK brush was ineffective. Results of Patel, Piazza et al. are not surprising because autistic children may prefer naturally softer, smoother foods (e.g., yogurt, applesauce) and reject foods that require more chewing (greater effort) due to oral-motor dysfunction or delayed oral-motor skills (Aponte & Romanczyk, 2016; Rommel et al., 2003).

Packing

Packing occurs when a child holds or pockets a prespecified amount of food or liquid in the mouth instead of swallowing and is another behavior that may emerge in the chain of eating as treatment progresses (Arvedson & Brodsky, 2002; Sevin et al., 2002). Packing poses significant health concerns including decreased calorie intake and risk of aspiration (Gulotta et al., 2005).

Common consequence-based treatments for packing include re-distribution, swallow facilitation, and a chaser (Gulotta et al., 2005; Levin et al., 2014; Vaz et al., 2012). Re-distribution involves gathering food from the mouth and re-presenting the bite on the tongue with a NUK brush or other feeding utensil, such as a small maroon spoon (e.g., Bloomfield et al., 2021;

Gulotta et al., 2005; Milnes et al., 2019; Volkert et al., 2011). Gulotta et al. (2005) used redistribution with a NUK brush to decrease packing and increase consumption in a child with developmental delays and a feeding disorder. Swallow facilitation involves applying light pressure while depositing the bite on the tongue (Hoch et al., 1995; Levin et al., 2014; Volkert et al., 2011). Results of Volkert et al. (2011) indicated that redistribution and swallow facilitation with a flipped spoon resulted in lower levels of packing for two children, one of which was autistic. A chaser involves presenting a liquid or solid that is consistently swallowed (Vaz et al., 2012) after acceptance of a liquid or solid that is less likely to be swallowed. Vaz et al. (2012) decreased packing for three children, one who was autistic and one with developmental delays, using a liquid or pureed fruit chaser after acceptance.

Antecedent procedures to treat packing include utensil or texture manipulations and simultaneous presentation (e.g., Buckley & Newchok, 2005; Dempsey et al., 2011; Milnes et al., 2019; Patel et al., 2005; Rivas et al., 2011; Stubbs et al., 2017; Volkert et al., 2011; Whipple et al., 2019). A flipped spoon procedure with purees involves the feeder inserting an upright spoon into the mouth, turning the spoon 180°, and dragging the bowl of the spoon on the child's tongue to deposit the bolus on the middle of the tongue (Dempsey et al., 2011; Rivas et al., 2011). Other researchers have shown the effectiveness of manipulating food texture to reduce the response effort associated with swallowing as a method to reduce packing. For example, packing decreased for three children with developmental disabilities when Patel et al. (2005) decreased texture from a higher textured foods (e.g., wet ground) to lower textured foods (e.g., baby food). Simultaneously presenting preferred and nonpreferred foods may alter the establishing operations for chewing and swallowing nonpreferred foods and thus decrease packing (e.g., Buckley and Newchok, 2005; Whipple et al., 2019). Buckley and Newchok (2005) decreased packing in an autistic child by simultaneously presenting a bite of ground cookie (a preferred food) on a spoon behind the target food.

Although packing may be conceptualized as part of the same response class as other problem behavior (e.g., inappropriate mealtime behavior or expulsion), it is possible that children with feeding difficulties pack food because they do not have the appropriate oral-motor skills to consume foods. Appropriate consumption of higher texture foods requires more refined skills (i.e., tongue lateralization, chewing, bolus formation) compared to lower textures. When introduction to solid foods is delayed due to enteral feedings or a child's diets primarily consist of "meltable solids," they miss opportunities to develop more advanced oral-motor skills (Peterson et al., 2018). Pre-treatment antecedent assessments can help identify textures that are compatible with the child's current oral-motor skills to identify conditions under which to initiate treatment or texture fading (e.g., Kadey et al., 2013a; Sharp & Jaquess, 2009). However, treatment procedures to increase other oral-motor skills (e.g., biting off food, tongue lateralization) may also be necessary.

Increasing Chewing

It is a common misconception that autistic children exhibiting food selectivity do not have chewing difficulties when they consume table texture foods. However, delayed chewing skills frequently occur in autistic children (Collins et al., 2003). Foods that are common to the diets of autistic children exhibiting food selectivity (e.g., chips, crackers, cookies) are considered "meltable solids" or foods that soften with exposure to saliva and break down easily by gumming or mashing them with minimal chewing. Even consumption of a hot dog involves less mature chewing skills and less response effort than safe an appropriate consumption of chicken or a hamburger. It is likely that skill deficits (e.g., limited chew strength) or increased response effort also play a role in the foods that autistic children consistently consume.

To date, there are limited treatment studies to increase chewing skills (Butterfield & Person, 1973; Eckman et al., 2008; Kadey et al., 2013b;

Taylor, 2020; Volkert et al., 2013, 2014). Only a few studies included autistic children (e.g., Kadey et al., 2013b; Taylor, 2020). The most common procedure to increase chewing is least-to-most prompting, which involves verbal, gestural, and physical prompts (Volkert et al., 2013, 2014). A verbal prompt includes verbal instructions to chew a certain number of times. A gestural prompt involves the feeder modeling appropriate chewing. A physical prompt involves manually guiding chews. Volkert et al. (2014) used least-to-most prompting with small bites of food placed loosely in the mouth, strips of food held on the child's molars, and bites of food placed in a chew tube held on the child's molars with three children with no to little experience consuming table texture food. Results indicated an increase in chews per bite and mastication (i.e., the food is broken down enough to safely swallow) and a decrease in premature swallowing for all children. Kadey, Roane, and colleagues (2013b) presented a choice between a small reinforcer for gradually increasing chews or a large reinforcer for the target number of chews and swallowing to increase chewing of target foods in an autistic child. When the choice alone was ineffective, they added physical guidance (i.e., the therapist gently placed one, open-palmed hand on the child's head, the index finger of the other hand under the child's chin, and the thumb of the other hand under the child's lower lip while applying gentle downward and upward pressure). Although chewing increased to the target number of chews, swallowing did not occur. Therefore, a swallow-prompt (i.e., quickly moving the NUK brush across the middle section of the tongue without pressure) was gradually introduced across each target food to increase swallowing.

Increasing Self-Feeding

Children with feeding problems may not feed themselves because they lack the skills to, are not motivated to, or both (Peterson et al., 2017; Volkert et al., 2016). When children have the skills to feed themselves but lack the motivation, intervention often includes reinforcement-based procedures and manipulating response effort (Peterson et al., 2015, 2017; Rivas et al., 2014; Vaz et al., 2011). For example, Rivas et al. (2014) manipulated bite number with two typically developing children and bite number and food type with one child diagnosed with a pervasive developmental disorder not otherwise specified to increase self -feeding. During bite number manipulation, the caregiver fed the child more bites if the child did not self-feed independently, and during the food type manipulation, if the child did not self-feed the bite, the caregiver fed more bites of a lesser preferred food.

Backward chaining is an effective method to teach children to feed themselves when they lack the skills (Hagopian et al., 1996). For example, Hagopian et al. (1996) used backward chaining to shape cup drinking with an autistic child. The target response of water consumption was broken into three main components, and reinforcement was provided for compliance at each step.

Alternative Approaches to Treatment

The effects of poor nutrition, such as impaired cognitive development and hyperactivity are often seen in autistic children who exhibit food selectivity (Bellise, 2004). Given the role that nutrition plays on brain function and cognitive development during preschool years, such as working memory, attention, and inhibitory control, early intervention is critical to help improve symptoms of feeding difficulties (Nyaradi et al., 2013; Peterson et al., 2019; Rosales et al., 2009).

Despite the effectiveness of behavior-analytic treatments to treat feeding problems, interventions with limited empirical support are often the first-line treatments for feeding difficulties (Peterson et al., 2017; Sharp et al., 2010; Volkert & Piazza, 2012). Pediatricians and other providers may advise caregivers to "wait and see" if feeding difficulties resolve without treatment, suggesting that children will "grow out of" their difficulties. To the contrary, Schreck and colleagues (2006) interviewed families of children with feeding difficulties up to 12 years of age and found that the autistic children did not outgrow their feeding problems. Additionally, the "wait and see" method may be dangerous and place children at risk for additional health concerns including but not limited to malnutrition, dehydration, constipation, and obesity-related conditions later in life. Peterson et al. (2019) conducted a randomized-control trial of an applied behavior analytic intervention or a wait-list control with six autistic children who exhibited food selectivity. Results indicated that the behavior analytic intervention was effective at increasing consumption of target foods for all children, and consumption increased for children in the wait-list control group only after the behavior analytic intervention was implemented.

Researchers have also compared the effects of behavior-analytic interventions to nonbehavior-analytic treatment approaches, such as nutritional counseling and sensory-based therapies (Addison et al., 2012; Benoit et al., 2000; Peterson et al., 2016). For example, Addison et al. (2012) compared the effects of a behavior-analytic intervention (i.e., noncontingent reinforcement and escape extinction) to a sensory integration intervention (e.g., therapeutic brushing, joint compression) that was designed by speech and language pathologists and occupational therapists with two children with feeding difficulties, one with a history of developmental delays. Acceptance and consumption increased, and inappropriate mealtime behavior decreased during the behavior-analytic intervention but not the sensory integration intervention. Similarly, Peterson et al. (2016) conducted a randomized control trial of a behavior analytic intervention (i.e., noncontingent reinforcement and escape extinction) versus a modified-sequential oral sensory approach (M-SOS) to treat the food selectivity of six autistic children. Modified-SOS (termed "modified" because changes to the SOS procedure were made to scientifically evaluate the procedures) consisted of introducing food (an "anxiety-provoking" stimulus) using a hierarchy of gradually more involvement with the food and removing the food to return to a lower step in the hierarchy if the child's stress was too high. Results showed that the behavior analytic intervention was effective at increasing consumption of target foods for all children, and consumption increased for children in the M-SOS intervention group only after the behavior analytic intervention was implemented.

Ethical Considerations

Given the high prevalence of feeding difficulties in autistic children, it is common for practicing behavior analysts to encounter children who exhibit feeding difficulties that warrant intervention. However, The Ethics Code for Behavior Analysts (Behavior Analyst Certification Board [BACB], 2022) requires that behavior analysts act in the best interest of clients, taking appropriate steps to support client's rights, maximize benefits, and do no harm (Section 3.01). To this end, there are several factors to consider ensuring the behavior analyst is providing ethical treatment within this specialized area.

For example, Section 2.12 indicates that behavior analysts should ensure medical needs are assessed and addressed if there is any reasonable likelihood that a behavior is influenced by medical or biological variables, and Sections 2.10 and 3.06 indicate that behavior analysts should collaborate and consult with colleagues from other professions in the best interest of the client (BACB, 2022). Medical issues and oral-motor delays or abnormalities are common factors that contribute to the development and maintenance of feeding difficulties, including food selectivity. These biological factors can serve as establishing operations for the reinforcers maintaining refusal and influence the effectiveness of behavioral interventions (Rommel et al., 2003). More importantly, using behavioral interventions with untreated medical conditions or unidentified oral-motor concerns could worsen the child's medical status and/or feeding difficulties. Given the often-complex etiology of feeding difficulties, an interdisciplinary approach to treating difficulties is necessary (Piazza, 2008; Silverman, 2010; Volkert & Piazza, 2012).

The Ethics Code for Behavior Analysts (BACB, 2022) also states that the behavior analyst should provide services that are conceptually consistent with behavioral principles, based on scientific evidence, and designed to maximize desired outcomes and protect clients and research participants from harm (Section 2.01). Behavior analysts should first conduct assessments that are conceptually consistent with behavioral principles and based on scientific evidence with a focus on maximizing benefits and minimizing risk of harm to the client (Section 2.13), and then, only implement restrictive or punishment-based procedures after demonstrating that desired results have not been obtained using less intrusive means (Section 2.15; BACB, 2022). These ethical considerations are nuanced when treating feeding difficulties, and unsafe or ineffective services can have serious consequences, such as creating behavioral resistance to future treatment, exacerbating unidentified or untreated medical conditions, malnutrition, weight loss, dehydration, allergic reactions, choking, aspiration, and even death.

The goal when treating feeding difficulties is to safely progress the child from their current feeding status to age-typical eating behaviors that meet their nutritional status in a systematic manner. To this end, it is important to first assess the individual responses within the chain of eating (e.g., bolus formation, tongue lateralization, and chewing) to (a) determine if the responses are developmentally appropriate or require additional intervention and (b) inform treatment selection that both accommodates for skill deficit and safely supports appropriate development of eating. It is also important to systematically integrate interventions to safely and effectively progress through the complex chain of responses that comprise eating to achieve the goal of age-typical eating. Although behavioral interventions have the most empirical support to treat feeding difficulties, the empirical support differs from that of teaching other skills (e.g., verbal behavior) or decreasing other problem behaviors (e.g., self-injury). We cannot necessarily generalize the findings of studies to address other behavior; thus, it is important that interventions are developed based on the scientific evidence to treat feeding difficulties. It is also important to consider (a) the potential side effects of common procedures used to treat feeding difficulties and (b) how to manage those factors to provide safe, socially acceptable, and effective treatment. For example, pairing a preferred food/liquid with a nonpreferred one (simultaneously or consecutively) or changing the presentation format of the preferred food/liquid may result in the client refusing it. This may be of particular concern if that food comprises a large portion of the client's calories or nutrition or the refusal generalizes to other preferred foods. As another example, antecedent manipulations that may enhance the effectiveness of other procedures and preclude the need for more intrusive procedures are nuanced in the context of treating feeding difficulties (e.g., food texture, bolus size, demand within the chain of eating), and a client's oral motor structure and skills may impact how the manipulations influence motivation and whether the manipulations are safe for the client. The selected behavioral treatment must also be implemented safely, effectively, and efficiently to maximize benefits and prevent harm. When implementing escape extinction procedures, additional safety concerns need to be considered, such as choking and aspiration. Further, ineffective implementation of escape extinction procedures can lead to behavior being more resistant to change.

Another expectation is that behavior analysts practice, supervise or train others, and conduct research only within the boundaries of their competence (BACB, 2022). This is defined as commensurate with their education, training, and supervised experience (Bailey & Burch, 2016). As such, behavior analysts engage in professional activities in new areas (e.g., populations or procedures) only after they seek the appropriate training and become demonstrably competent, or they collaborate with other professionals who have the required competence (Section 1.05; Section 6.06). As noted by Bailey and Burch (2016), "practitioners will have to determine whether they are indeed competent in certain subspecialties of applied behavior analysis, such as feeding problems and self-injurious behavior. Attending a workshop or seminar on one of these specialties is not sufficient to describe oneself as competent in a subspecialty area" (p. 58).

Basic knowledge of gastrointestinal conditions, nutrition, and oral-motor development is necessary to (a) understand medical, nutritional, and oral-motor concerns that may be contributing to feeding difficulties, (b) develop safe and effective therapy goals and behavioral interventions, and (c) assist in monitoring the influence of these concerns on treatment progress. Additionally, specialized skills in selecting, implementing, and evaluating empirically supported behavior-analytic interventions to treat feeding difficulties are necessary to maximize benefits and prevent harm. Knowledge of disordered feeding patterns and specialized skills in assessing and treating skill and/or motivational deficits within the chain of eating in a systematic and integrated progression is necessary to achieve age-typical eating safely, effectively, and efficiently. Thus, competence to treat feeding problems should be developed by receiving (a) adequate didactic training on factors that may contribute to the development and maintenance of feeding difficulties as well as the extant behavior analytic literature; (b) extensive hands-on training conducting behavioral assessment, and developing, implementing, and evaluating behavioral interventions with multiple individuals exhibiting a range of feeding difficulties, supervised by a behavior analyst competent in assessing and treating feeding problems; and (c) experience using an interdisciplinary approach to treating feeding difficulties.

Practicing outside of one's competency in the specialized area of feeding problems can have serious and detrimental outcomes, from exacerbating the feeding difficulties to, in the severest situation, a medical emergency or death. When a behavior analyst does not have sufficient training to effectively assess and treat feeding difficulties without the risk of doing harm, the behavior analyst must either seek consultation or supervision from or refer the client to a behavior analyst who is competent in this specialized area (Section 2.10; Section 3.03; Section 3.13).

Summary

Feeding problems are common among autistic children. Although food selectivity is the most common problem among autistic children, they may also exhibit inadequate intake (fewer calories than needed to grow), refusal of all foods or liquids, liquid dependence, delayed self-feeding skills, or a combination of these problems (Bandini et al., 2010). Behavior-analytic interventions have the most empirical support to treat feeding problems exhibited by autistic children (Ledford & Gast, 2006; Laud et al., 2009). It is not uncommon for medical factors and skill deficits to contribute to and exacerbate these problems. Thus, feeding problems should not be considered just another behavioral problem exhibited by autistic children and should be treated within an interdisciplinary approach. Given the high prevalence of feeding problems among autistic children, behavior analysts will likely encounter clients with feeding problems in their career. It is imperative that behavior analysts develop competency or receive ongoing supervision or consultation if they treat feeding problems due to the complexity and heterogeneity of feeding problems and the potential risks of ineffective or unsafe treatment.

Although the extant literature includes assessment and intervention methodologies that have allowed for the effective treatment of feeding problems, more research is needed to further examine the effectiveness of these procedures to treat a wide range of feeding problems exhibited by autistic children. We also need more comprehensive assessments that (a) efficiently evaluate the interactive effects between antecedent variables and common consequences maintaining problem behavior during mealtimes, including expulsions and packing, (b) identify skill versus motivational deficits, and (c) effectively prescribe the most effective, efficient, and specific treatments. As the prevalence of feeding problems is high amongst autistic children, it is imperative that practitioners are provided with tools to help them develop and evaluate their competency to treat feeding problems. Future research should focus on increasing opportunities for practitioners to utilize research-supported treatment manuals and to participate in training programs to ensure they are providing effective and safe treatments. Lastly, ethical decision-making models would provide practitioners with a guide on how to decide when it is appropriate to treat, seek consultation, or refer.

References

Addison, L. R., Piazza, C. C., Patel, M. R., Bachmeyer, M. H., Rivas, K. M., Milnes, S. M., & Oddo, J. (2012). A comparison of sensory integrative and behavioral therapies as treatment for pediatric feeding disorders. *Journal of Applied Behavior Analysis, 45*(3), 455–471. https://doi.org/10.1901/jaba.2012.45-455

Ahearn, W. H. (2002). Effect of two methods of introducing foods during feeding treatment on acceptance of previously rejected items. *Behavioral Interventions, 17*, 111–127. https://doi.org/10.1002/bin.112

Ahearn, W. H. (2003). Using simultaneous presentation to increase vegetable consumption in a mildly selective child with autism. *Journal of Applied Behavior Analysis, 36*(3), 361–365. https://doi.org/10.1901/jaba.2003.36-361

Ahearn, W. H., Kerwin, M. L., Eicher, P. S., Shantz, J., & Swearingin, W. (1996). An alternating treatments comparison of two intensive interventions for food refusal. *Journal of Applied Behavior Analysis, 29*(3), 321–332. https://doi.org/10.1901/jaba.1996.29-321

Ahearn, W. H., Castine, T., Nault, K., & Green, G. (2001). An assessment of food acceptance in children with autism or pervasive developmental disorder – Not otherwise specified. *Journal of Autism and Developmental Disorders, 31*, 501–511. https://doi.org/10.1023/A:1012221026124

Allison, J., Wilder, D. A., Chong, I., Lugo, A., Pike, J., & Rudy, N. (2012). A comparison of differential reinforcement and noncontingent reinforcement to treat food selectivity in a child with autism. *Journal of Applied Behavior Analysis, 45*(3), 613–617. https://doi.org/10.1901/jaba.2012.45-613

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Aponte, C. A., & Romanczyk, R. G. (2016). Assessment of feeding problems in children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 21*, 61–72. https://doi.org/10.1016/j.rasd.2015.09.007

Arvedson, J. C., & Brodsky, L. (2002). *Pediatric swallowing and feeding: Assessment and management* (2nd ed.). Singular Publishing Group. https://doi.org/10.1016/S0165-5876(02)00205-7

Babbitt, R. L., Hoch, T. A., & Coe, D. A. (1994). Behavioral feeding disorders. In D. N. Tuchman & R. S. Walter (Eds.), *Disorders of feeding and swallowing in infants and children: Physiology, diagnosis, and treatment* (pp. 77–95). Singular Publishing Group.

Bachmeyer, M. H. (2009). Treatment of selective and inadequate food intake in children: A review and practical guide. *Behavior Analysis in Practice, 2*, 43–50. https://doi.org/10.1007/BF03391736

Bachmeyer, M. H., Piazza, C. C., Fredrick, L. D., Reed, G. K., Rivas, K. D., & Kadey, H. J. (2009). Functional analysis and treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 42*, 641–658. https://doi.org/10.1901/jaba.2009.42-641

Bachmeyer, M. H., Gulotta, C. S., & Piazza, C. C. (2013). Liquid to baby food fading in the treatment of food refusal. *Behavioral Interventions, 28*(4), 281–298. https://doi.org/10.1002/bin.1367

Bailey, J., & Burch, M. (2016). *Ethics for behavior analysts* (3rd ed.). Routledge. https://doi.org/10.4324/9781315669212

Bandini, L. G., Anderson, S. E., Curtin, C., Cermak, S., Evans, E. W., Scampini, R., Maslin, M., & Must, A. (2010). Food selectivity in children with autism spectrum disorder and typically developing children. *The Journal of Pediatrics, 157*, 259–264. https://doi.org/10.1016/j.jpeds.2012.02.013

Barnhill, K., Gutierrez, A., Ghossainy, M., Marediya, Z., Devlin, M., Sachdev, P., Marti, C. N., & Hewitson, L. (2018). Dietary status and nutrient intake of children with autism spectrum disorder: A case-control study. *Research in Autism Spectrum Disorders, 50*, 51–59. https://doi.org/10.1016/j.rasd.2018.03.002

Behavior Analyst Certification Board. (2022). *Ethics code for behavior analysts.* https://bacb.com/wp-content/ethics-code-for-behavior-analysts/

Bellise, F. (2004). Effects of diet on behaviour and cognition in children. *British Journal of Nutrition, 92*(52), S227–S2232. https://doi.org/10.1079/bjn20041171

Benoit, D., Wang, E. L., & Zlotkin, S. H. (2000). Discontinuation of enterostomy tube feeding by behavioral treatment in early childhood: A randomized controlled trial. *The Journal of Pediatrics, 137*(4), 498–503. https://doi.org/10.1067/mpd.2000.108397

Berth, D. P., Bachmeyer, M. B., Kirkwood, C. A., Mauzy, C. R., IV, Retzlaff, B. J., & Gibson, A. L. (2019). Noncontingent and differential reinforcement in the treatment of pediatric feeding problems. *Journal of Applied Behavior Analysis, 52*(3), 622–641. https://doi.org/10.1002/jaba.562

Bloomfield, B. S., Wawrzonek, A. J., & Volkert, V. M. (2021). Preliminary comparison of redistribution at different intervals to reduce packing in children with avoidant/restrictive food intake disorder. *Behavioral Development, 26*, 1–13. https://doi.org/10.1037/bdb0000098

Borrero, C. S. W., Woods, J. N., Borrero, J. C., Masler, E. A., & Lesser, A. D. (2010). Descriptive analyses of pediatric food refusal and acceptance. *Journal of Applied Behavior Analysis, 43*, 71–88. https://doi.org/10.1901/jaba.2010.43-71

Borrero, C. S. W., England, J. D., Sarcia, B., & Woods, J. N. (2016). A comparison of descriptive and functional analyses of inappropriate mealtime behavior. *Behavior Analysis in Practice, 9*(4), 364–379. https://doi.org/10.1007/s40617-016-0149-5

Brown, J. F., Spencer, K., & Swift, S. (2002). A parent training programme for chronic food refusal: A case study. *British Journal of Learning Disabilities, 30*(3), 118–121. https://doi.org/10.1046/j.1468-3156.2002.00128.x

Buckley, S. D., & Newchok, D. K. (2005). An evaluation of simultaneous presentation and differential reinforcement with response cost to reduce packing. *Journal of Applied Behavior Analysis, 38*(3), 405–409. https://doi.org/10.1901/jaba.2005.71-04

Butterfield, W. H., & Person, R. (1973). Modeling and shaping by parents to develop chewing behavior in their retarded child. *Journal of Behavior Therapy and Experimental Psychiatry, 4*(3), 285–287. https://doi.org/10.1016/00005-7916(73)90090-6

Chaidez, V., Hansen, R. L., & Hertz-Picciottom, I. (2014). Gastrointestinal problems in children with autism, developmental delays or typical development. *Journal of Autism and Developmental Disorders, 44*(5), 1117–1127. https://doi.org/10.1007/s10803-013-1973-x

Coe, D. A., Babbitt, R. L., Williams, K. E., Hajimihalis, C., Snyder, A. M., Ballard, C., & Efron, L. A. (1997). Use of extinction and reinforcement to increase food consumption and reduce expulsion. *Journal of Applied Behavior Analysis, 30*(3), 581–583. https://doi.org/10.1901/jaba.1997.30-581

Collins, M. S., Kyle, R., Smith, S., Laverty, A., Roberts, S., & Eaton-Evans, J. (2003). Coping with the usual family diet: Eating behaviour and food choices of children with Down's syndrome, autistic spectrum disorders or cri du chat syndrome and comparison groups of siblings. *Journal of Learning Disabilities, 7*(2), 137–155. https://doi.org/10.1177/1469004703007002004

Cooper, L. J., Wacker, D. P., Brown, K., Mccomas, J. J., Peck, S. M., Drew, J., Asmus, J., & Kayser, K. (1999). Use of a concurrent operants paradigm to evaluate positive reinforcers during treatment of food refusal. *Behavior Modification, 23*(1), 3–40. https://doi.org/10.1177/0145445599231001

Crowley, J. C., Peterson, K. M., Fisher, W. W., & Piazza, C. C. (2020). Treating food selectivity as resistance to change in children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 53*(4), 2002–2023. https://doi.org/10.1002/jaba.711

Curtin, C., Hubbard, K., Anderson, S. E., Mick, E., Must, A., & Bandini, L. G. (2015). Food selectivity, mealtime behavior problems, spousal stress, and family food choices in children with and without autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*(10), 3308–3015. https://doi.org/10.1007/s10803-015-2490-x

Dawson, J. E., Piazza, C. C., Sevin, B. M., Gulotta, C. S., Lerman, D., & Kelley, M. L. (2003). Use of the high-probability instructional sequence and escape extinction in a child with food refusal. *Journal of Applied Behavior Analysis, 36*(1), 105–108. https://doi.org/10.1901/jaba.2003.36-105

DeMand, A., Johnson, C., & Foldes, E. (2015). Psychometric properties of the brief autism mealtime behaviors inventory. *Journal of Autism and Developmental Disorders, 45*(9), 2667–2673. https://doi.org/10.1007/s10803-015-2435-4

Dempsey, J., Piazza, C. C., Groff, R. A., & Kozisek, J. M. (2011). A flipped spoon and chin prompt to increase mouth clean. *Journal of Applied Behavior Analysis, 44*(4), 961–965. https://doi.org/10.1901/jaba.2011.44-961

Eckman, N., Williams, K. E., Riegel, K., & Paul, C. (2008). Teaching chewing: A structured approach. *The American Journal of Occupational Therapy, 62*(5), 514–521. https://doi.org/10.5014/ajot.5.514

Erickson, C. A., Stigler, K. A., Corkins, M. R., Posey, D. J., Fitzgerald, J. F., & McDougle, C. J. (2005). Gastrointestinal factors in autistic disorder: A critical review. *Journal of Autism and Developmental Disorders, 35*(6), 713–727. https://doi.org/10.1007/s10803-005-0019-4

Esteban-Figuerola, P., Canals, J., Fernández-Cao, J. C., & Val, V. A. (2019). Differences in food consumption and nutritional intake between children with autism spectrum disorders and typically developing children: A meta-analysis. *Autism, 23*(5), 1079–1095. https://doi.org/10.1177/1362361318794179

Ewry, D. M., & Fryling, M. J. (2016). Evaluating the high-probability instructional sequence to increase the acceptance of foods with an adolescent with autism. *Behavior Analysis in Practice, 9*(4), 380–383. https://doi.org/10.1007/s40617-015-0098-4

Field, D., Garland, M., & Williams, K. (2003). Correlates of specific childhood feeding problems. *Journal of Pediatrics and Child Health, 39*, 299–304. https://doi.org/10.1046/j.1440-1754.2003.00151.x

Fisher, W. W., Greer, B. D., Romani, P. W., Zangrillo, A. N., & Owen, T. M. (2016). Comparisons of synthesized and individual reinforcement contingencies during functional analysis. *Journal of Applied Behavior Analysis, 49*(3), 596–616. https://doi.org/10.1002/jaba.314

Franklin, L., & Rodger, S. (2003). Parents' perspectives on feeding medically compromised children: Implications for occupational therapy. *Australian Occupational Therapy Journal, 50*, 137–147. https://doi.org/10.1046/j.1440-1630.2003.00375.x

Freeman, K. A., & Piazza, C. C. (1998). Combining stimulus fading, reinforcement, and extinction to treat food refusal. *Journal of Applied Behavior Analysis, 31*(4), 691–694. https://doi.org/10.1901/jaba.1998.31-691

Girolami, P. A., & Scotti, J. R. (2001). Use of analog functional analysis in assessing the function of mealtime behavior problems. *Education & Training in Mental Retardation & Developmental Disabilities, 36*, 207–223.

Girolami, P. A., Boscoe, J. H., & Roscoe, N. (2007). Decrease expulsions by a child with a feeding disorder: Using a brush to present a re-present food. *Journal of Applied Behavior Analysis, 40*(4), 749–753. https://doi.org/10.1901/jaba.2007.749-753

Greer, A. A., Gulotta, C. S., Masler, E. A., & Laud, R. B. (2008). Caregiver stress and outcomes of children with pediatric feeding disorders treated in an intensive interdisciplinary program. *Journal of Pediatric Psychology, 33*, 612–620. https://doi.org/10.1093/jpepsy/jsm116

Groff, R. A., Piazza, C. C., Zeleny, J. R., & Dempsey, J. R. (2011). Spoon-to-cup fading as treatment for cup drinking in a child with intestinal failure. *Journal of Applied Behavior Analysis, 44*(4), 949–954. https://doi.org/10.1901/jaba.2011.44-949

Gulotta, C. S., Piazza, C. C., Patel, M. R., & Layer, S. A. (2005). Using food redistribution to reduce packing in children with severe food refusal. *Journal of Applied Behavior Analysis, 38*(1), 39–50. https://doi.org/10.1901/jaba.2005.168-03

Hagopian, L. P., Farrell, D. A., & Amaria, A. (1996). Treating total liquid refusal with backward chaining and fading. *Journal of Applied Behavioral Analysis, 29*(4), 573–575. https://doi.org/10.1901/jaba.1996.29-573

Hoch, T. A., Babbitt, R. L., Coe, D. A., Krell, D. M., & Hackbert, L. (1994). Contingency contracting: Combining positive reinforcement and escape extinction procedures to treat persistent food refusal. *Behavior Modification, 18*(1), 106–128. https://doi.org/10.1177/01454455940181007

Hoch, T. A., Babbitt, R. L., Coe, D. A., Ducan, A., & Trusty, E. M. (1995). A swallow induction avoidance procedure to establish eating. *Journal of Behavior Therapy and Experimental Psychiatry, 26*, 41–50. https://doi.org/10.1016/0005-7916(94)00067-V

Ibañez, V. F., Peters, K. P., & Vollmer, T. R. (2021). A comparison of re-presentation and modified chin prompt to treat different topographies of liquid expulsion. *Journal of Applied Behavior Analysis, 549*(4), 1586–1607. https://doi.org/10.1901/jaba.2021.54-1586

Ibrahim, S. H., Voigt, R. G., Katusic, S. K., Weaver, A. L., & Barbaresi, W. J. (2008). Incidence of gastrointestinal symptoms in children with autism: A population-based study. *Pediatrics, 124*(2), 680–686. https://doi.org/10.1542/peds.2008-2933

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209. (Reprinted from *Analysis and Intervention in Developmental Disabilities, 2,* 3–20, 1982).. https://doi.org/10.1901/jaba.1994.27-197

Johnson, C. R., & Babbitt, R. L. (1993). Antecedent manipulation in the treatment of primary solid food refusal. *Behavior Modification, 17*(4), 510–521. https://doi.org/10.1177/01454455930174006

Kadey, H. J., Piazza, C. C., Rivas, K. M., & Zeleny, J. (2013a). An evaluation of texture manipulations to increase swallowing. *Journal of Applied Behavior Analysis, 46*(2), 539–543. https://doi.org/10.1002/jaba.33

Kadey, H. J., Roane, H. S., Diaz, J. C., & McCarthy, C. M. (2013b). Using a Nuk® brush to increase acceptance of solids and liquids for two children diagnosed with autism. *Research in Autism Spectrum Disorders, 7*(11), 1461–1480. https://doi.org/10.1016/j.rasd.2013.07.017

Keen, D. V. (2008). Childhood autism, feeding problems, and failure to thrive in early infancy. *European Child & Adolescent Psychiatry, 17*(4), 209–216. https://doi.org/10.1007/s00787-007-0655-7

Kennedy, G. A., Wick, M. R., & Keel, P. K. (2018). Eating disorders in children; is avoidant-restrictive food intake disorder a feeding disorder or an eating disorder and what are the implications for treatment? *F1000Research, 7*, 88. https://doi.org/10.12688/f1000research.13110.1

Kern, L., & Marder, T. J. (1996). A comparison of simultaneous and delayed reinforcement as treatments for food selectivity. *Journal of Applied Behavior Analysis, 29*(2), 243–246. https://doi.org/10.1901/jaba.29-243

Kerwin, M. E., Ahearn, W. H., Eicher, P. S., & Burd, D. M. (1995). The costs of eating: A behavioral economic food analysis of food refusal. *Journal of Applied Behavior Analysis, 28*, 245–260. https://doi.org/10.1901/jaba.1995.28-245

Kerwin, M. E., Eicher, P. S., & Gelsinger, J. (2005). Parental report of eating problems and gastrointestinal symptoms in children with pervasive developmental disorders. *Children's Health Care, 34*(3), 217–234. https://doi.org/10.1207/s15326888chc3403_4

Kirkwood, C. A., Bachmeyer-Lee, M. H., Sheehan, C. M., Mauzy, C. R., IV, & Gibson, L. A. (2020). Further examination of the treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis*, 1–22. https://doi.org/10.1002/jaba.738

Kirkwood, C. A., Piazza, C. C., & Peterson, K. M. (2021). A comparison of function- and nonfunction-based extinction treatments for inappropriate mealtime behavior. *Journal of Applied Behavior Analysis., 54, 928.*

Kodak, T., & Piazza, C. (2008). Assessment and behavioral treatment of feeding and sleeping disorders in children with autism spectrum disorders. *Child and Adolescent Psychiatric Clinics of North America, 17*(4), 887–905. https://doi.org/10.1016/j.chc.2008.06.005

Konst, M. J., Lesser, A. D., McMahon, M., & Gonzalez, M. (2017). The impact of food viscosity and preference on treating a feeding problem. *Journal of Developmental and Physical Disabilities, 29*, 547–555. https://doi.org/10.1007/s10882-017-9542-4

Laud, R. B., Girolami, P. A., Boscoe, J. H., & Gulotta, C. S. (2009). Treatment outcomes for severe feeding problems in children with autism spectrum disorder. *Behavior Modification, 33*(5), 520–536. https://doi.org/10.1177/0145445509346729

Ledford, J. R., & Gast, D. L. (2006). Feeding problems in children with autism spectrum disorders: A review. *Focus on Autism and Other Developmental Disabilities, 21*(3), 153–166. https://doi.org/10.1177/10883576060210030401

Levin, D. S., & Carr, E. G. (2001). Food selectivity and problem behavior in children with developmental disabilities. Analysis and intervention. *Behavior Modification, 25*(3), 443–470. https://doi.org/10.1177/0145445501253004

Levin, D. S., Volkert, V. M., & Piazza, C. C. (2014). A multi-component treatment to reduce packing in children with feeding and autism spectrum disorders.

Behavior Modification, 38(6), 940–963. https://doi.org/10.1177/0145445514550683

Levy, S. E., Souders, M. C., Ittenbach, R. F., Giarelli, E., Mulberg, A., & Pinto-Martin, J. (2007). Relationship of dietary intake to gastrointestinal symptoms in children with autistic spectrum disorders. *Biological Psychiatry, 61*(4), 492–497. https://doi.org/10.1016/j.biopsych.2006.07.013

Luiselli, J. K., Ricciardi, J. N., & Gilligan, K. (2005). Liquid fading to establish milk consumption by a child with autism. *Behavioral Interventions, 20*(2), 155–163. https://doi.org/10.1002/bin.187

Michael, J. (1993). Establishing operations. *The Behavior Analyst, 16*, 191–206. https://doi.org/10.1007/BF03392623

Miller, C. K., Burklow, K. A., Santoro, K., Kirby, K., Mason, D., & Rudolph, C. D. (2001). An interdisciplinary team approach to management of pediatric feeding and swallowing disorders. *Children's Health Care, 30*(3), 201–218. https://doi.org/10.1207/S15326888CHC3003_3

Milnes, S. M., Piazza, C. C., Ibañez, V. F., & Kozisek, J. M. (2019). A comparison of Nuk Presentation and Nuk redistribution to treat packing. *Journal of Applied Behavior Analysis, 52*(2), 476–490. https://doi.org/10.1901/jaba.2019.52-476

Mueller, M. M., Piazza, C. C., Patel, M. R., Kelley, M. E., & Pruett, A. (2004). Increasing variety of foods consumed by blending nonpreferred foods into preferred foods. *Journal of Applied Behavior Analysis, 37*, 159–170. https://doi.org/10.1901/jaba.2004.37-159

Munk, D. D., & Repp, A. C. (1994). Behavioral assessment of feeding problems of individuals with severe disabilities. *Journal of Applied Behavior Analysis, 27*, 241–250. https://doi.org/10.1901/jaba.1994.27-241

Najdowski, A. C., Wallace, M. D., Doney, J. K., & Ghezzi, P. M. (2003). Parental assessment and treatment of food selectivity in natural settings. *Journal of Applied Behavior Analysis, 36*(3), 383–386. https://doi.org/10.1901/jaba.2003.36-383

Najdowski, A. C., Wallace, M. D., Penrod, B., Tarbox, J., Reagon, K., & Higbee, T. S. (2008). Caregiver-conducted experimental functional analyses of inappropriate mealtime behavior. *Journal of Applied Behavior Analysis, 41*, 459–465. https://doi.org/10.1901/jaba.2008.41-459

Nyaradi, A., Li, J., Hickling, S., Foster, J., & Oddy, W. H. (2013). The role of nutrition in children's neurocognitive development, from pregnancy through childhood. *Frontiers in Human Neuroscience, 7*, 1–16. https://doi.org/10.3389/fnhum.2013.00097

Patel, M. R., Piazza, C. C., Kelly, M. L., Ochsner, C. A., & Santana, C. M. (2001). Using a fading procedure to increase fluid consumption in a child with feeding problems. *Journal of Applied Behavior Analysis, 34*(3), 357–360. https://doi.org/10.1901/jaba.2001.34-357

Patel, M. R., Piazza, C. C., Martinez, C. J., Volkert, V. M., & Santana, C. M. (2002a). An evaluation of two differential reinforcement procedures with escape extinction to treat food refusal. *Journal of Applied Behavior Analysis, 35*(4), 363–374. https://doi.org/10.1901/jaba.2002.35-363

Patel, M. R., Piazza, C. C., Santana, C. M., & Volkert, V. M. (2002b). An evaluation of food type and texture in the treatment of a feeding problem. *Journal of Applied Behavior Analysis, 35*, 363–374. https://doi.org/10.1901/jaba.2002.35-183

Patel, M. R., Piazza, C. C., Layer, S. A., Coleman, R., & Swartzwelder, D. M. (2005). A systematic evaluation of food textures to decrease packing and increase oral intake in children with pediatric feeding disorders. *Journal of Applied Behavior Analysis, 28*(1), 89–100. https://doi.org/10.1901/jaba.2005.161-02

Patel, M. R., Reed, G. K., Piazza, C. C., Bachmeyer, M. H., Layer, S. A., & Pabico, R. S. (2006). An evaluation of a high-probability instructional sequences to increase acceptance of food and decrease inappropriate behavior in children with pediatric feeding disorders. *Research in Developmental Disabilities, 27*(4), 430–442. https://doi.org/10.1016/j.ridd.205.05.005

Patel, M. R., Reed, G. K., Piazza, C. C., Mueller, M., Bachmeyer, M. H., & Layer, S. A. (2007). Use of a high-probability instructional sequence to increase compliance to feeding demands in the absence of escape extinction. *Behavioral Interventions, 22*(4), 305–310. https://doi.org/10.1002/bin.251

Penrod, B., Gardella, L., & Fernand, J. (2012). An evaluation of a progressive high-probability instructional sequence combined with low-probability demand fading in the treatment of food selectivity. *Journal of Applied Behavior Analysis, 45*(3), 527–537. https://doi.org/10.1901/jaba.2012.45-527

Peterson, K. M., Volkert, V. M., & Zeleny, J. R. (2015). Increasing self-drinking for children with feeding disorders. *Journal of Applied Behavior Analysis, 28*(2), 436–441. https://doi.org/10.1002/jaba.210

Peterson, K. M., Piazza, C. C., & Volkert, V. M. (2016). A comparison of a modified sequential oral sensory approach to an applied behavior-analytic approach in the treatment of food selectivity in children with autism spectrum disorders. *Journal of Applied Behavior Analysis, 49*(4), 1–27. https://doi.org/10.1002/jaba.332

Peterson, K. M., Volkert, V. M., & Milnes, S. M. (2017). Evaluation of practice trials to increase self-drinking in a child with a feeding disorder. *Behavior Analysis in Practice, 27*(2), 167–171. https://doi.org/10.1007/s40617-016-0147-7

Peterson, K. M., Ibañez, V. F., Kirkwood, C. A., Crowley, J. G., & Piazza, C. C. (2018). Assessment of pediatric feeding disorders. In J. Matson (Ed.), *Handbook of childhood psychopathology and developmental disabilities assessment* (pp. 415–431). Springer.

Peterson, K. M., Piazza, C. C., Ibañez, V. F., & Fisher, W. W. (2019). Randomized controlled trial of an applied behavior analytic intervention for food selectivity in children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 52*(4), 895–917. https://doi.org/10.1002/jaba.650

Piazza, C. C. (2008). Feeding disorders and behavior: What have we learned? *Developmental Disabilities Research Reviews, 14*, 174–181. https://doi.org/10.1002/ddrr.22

Piazza, C. C., Patel, M. R., Santana, C. M., Goh, H., Delia, M., & Lancaster, B. M. (2002). An evaluation of simultaneous sequential presentation and non-preferred food to treat food selectivity. *Journal of Applied Behavior Analysis, 35*(3), 259–270. https://doi.org/10.1901/jaba.2002.35-259

Piazza, C. C., Fisher, W. W., Brown, K. A., Shore, B. A., Patel, M. R., Katz, R. M., Sevin, B. M., Gulotta, C. S., & Blakely-Smith, A. (2003a). Functional analysis of inappropriate mealtime behaviors. *Journal of Applied Behavior Analysis, 36*, 187–204. https://doi.org/10.1901/jaba.2003.36-187

Piazza, C. C., Patel, M. R., Gulotta, C. S., Sevin, B. M., & Layer, S. A. (2003b). On the relative contributions of positive reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis, 36*(3), 309–324. https://doi.org/10.1901/jaba.2003.36-309

Reed, G. K., Piazza, C. C., Patel, M. R., Layer, S. A., Bachmeyer, M. H., Bethke, S. D., & Gutshall, K. A. (2004). On the relative contributions of noncontingent reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis, 37*(1), 27–42. https://doi.org/10.1901/jaba.2004.37-27

Riordan, M. M., Iwata, B. A., Wohl, M. K., & Finney, J. W. (1980). Behavioral treatment of food refusal and selectivity in developmentally disabled children. *Applied Research in Mental Retardation, 1*(1–2), 95–112. https://doi.org/10.1016/0270-3092(80)90019-3

Riordan, M. M., Iwata, B. A., Finney, J. W., Wohl, M. K., & Stanley, A. E. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis, 17*, 327–341. https://doi.org/10.1901/jaba.1984.17-327

Rivas, K. D., Piazza, C. C., Patel, M. R., & Bachmeyer, M. H. (2011). Spoon distance fading with an without escape extinction as treatment for food refusal. *Journal of Applied Behavior Analysis, 43*(4), 673–683. https://doi.org/10.1901/jaba.2010.43-673

Rivas, K. M., Piazza, C. C., Roane, H. S., Volkert, V. M., Stewart, V., Kadey, H. J., & Groff, R. A. (2014). Analysis of self-feeding in children with feeding disorders. *Journal of Applied Behavior Analysis, 47*(4), 1–13. https://doi.org/10.1901/jaba.170

Rommel, N., De Meyer, A. M., Feenstra, L., & Veereman-Wauters, G. (2003). The complexity of feeding problems in 700 infants and young children presenting to a tertiary care institution. *Journal of Pediatric Gastroenterology and Nutrition, 37*, 75–84. https://doi.org/10.1097/00005176-200307000-00014

Rosales, F. J., Reznick, J. S., & Zeisel, S. H. (2009). Understanding the role of nutrition in the brain and behavioral developmental of toddlers and preschool children: Identifying and overcoming methodological barriers. *Nutritional Neuroscience, 12*, 190–202. https://doi.org/10.1179/147683009X423454

Schreck, K. A., & Williams, K. (2006). Food preferences and factors influencing food selectivity for children with autism spectrum disorders. *Research in Developmental Disabilities, 27*(4), 353–363. https://doi.org/10.1016/j.ridd.2005.03.005

Schreck, K. A., Williams, K., & Smith, A. F. (2004). A comparison of eating behaviors between children with and without autism. *Journal of Autism and Developmental Disorders, 34*(4), 433–438. https://doi.org/10.1023/b:jadd.0000037419.78531.86

Sevin, B. M., Gulotta, C. S., Sierp, B. J., Rosica, L. A., & Miller, L. J. (2002). Analysis of response covariation among multiple topographies of food refusal. *Journal of Applied Behavior Analysis, 35*(1), 65–68. https://doi.org/10.1901/jaba.2002.35-65

Shalev, R. A., Milnes, S. M., Piazza, C. C., & Kozisek, J. M. (2018). Treating liquid expulsion in children with feeding disorders. *Journal of Applied Behavior Analysis, 51*(1), 70–79. https://doi.org/10.1002/jaba.435

Sharp, W. G., & Jaquess, D. L. (2009). Bite size and texture assessments to prescribe treatment for severe food selectivity in autism. *Behavioral Interventions, 24*, 157–170. https://doi.org/10.1002/bin.282

Sharp, W. G., Jaquess, D. L., Morton, J. F., & Herzinger, C. V. (2010). Pediatric feeding disorders: A quantitative synthesis or treatment outcomes. *Clinical Child and Family Psychology Review, 13*(4), 348–365. https://doi.org/10.1007/s10567-010-0079-7

Sharp, W. G., Jaquess, D. L., Morton, J. F., & Miles, A. G. (2011). A retrospective chart review of dietary diversity and feeding behavior of children with autism spectrum disorder before and after admission to a day treatment program. *Focus on Autism and Other Developmental Disabilities, 26*(1), 37–48. https://doi.org/10.1177/1088357609349245

Sharp, W. G., Odom, A., & Jaquess, D. L. (2012). Comparison of upright and flipped spoon presentations to guide treatment of food refusal. *Journal of Applied Behavior Analysis, 45*(1), 83–96. https://doi.org/10.1901/jaba.2012.45-83

Sharp, W. G., Volkert, V. M., & Raol, N. (2022). Evaluating characteristics associated with success with tube weaning after intensive multidisciplinary intervention. *Journal of Developmental & Behavioral Pediatrics, 43*(3), e204–e209. https://doi.org/10.1097/DBP.0000000000001000

Silverman, A. H. (2010). Interdisciplinary care for feeding problems in children. *Nutrition in Clinical Practice, 25*, 160–165. https://doi.org/10.1177/0884533610361609

Smith, R. G., & Iwata, B. A. (1997). Antecedent influences on behavior disorders. *Journal of Applied Behavior Analysis, 30*(2), 343–375. https://doi.org/10.1901/jaba.1997.30-343

Stubbs, K. H., Volkert, V. M., Rubio, E. K., & Ottinger, E. (2017). A comparison of flipped spoon presentation and redistribution to decrease packing in children with feeding disorders. *Learning and Motivation, 62*(1), 103–111. https://doi.org/10.1016/j.lmot.2017.03.007

Taylor, T. (2020). Increasing food texture and teaching chewing for a clinical case within the home setting in Australia. *Learning and Motivation, 71*, 1–14. https://doi.org/10.1016/j.lmot.2020.101651

Tiger, J. H., & Hanley, G. P. (2006). Using reinforcer pairing and fading to increase the milk consumption of a preschool child. *Journal of Applied Behavior Analysis, 39*(3), 399–403. https://doi.org/10.1901/jaba.2006.6-06

Twachtman-Reilly, J., Amaral, S. C., & Zebrowski, P. P. (2008). Addressing feeding disorders in children on the autism spectrum in school-based settings: Physiological and behavioral issues. *Language, Speech, and Hearing Services in Schools, 39*(2), 261–272. https://doi.org/10.1044/0161-1461(2008/025)

Valicenti-McDermott, M., McVicar, K., Rapin, I., Wershill, B. K., Cohen, H., & Shinnar, S. (2006). Frequency of gastrointestinal symptoms in children with autistic spectrum disorders and association with family history of autoimmune disease. *Journal of Developmental & Behavioral Pediatrics, 27*(2), S128–S136. https://doi.org/10.1097/00004703-200604002-00011

Vaz, P. C. M., Volkert, V. M., & Piazza, C. C. (2011). Using negative reinforcement to increase self-feeding in a child with food selectivity. *Journal of Applied Behavior Analysis, 44*(4), 915–920. https://doi.org/10.1901/jaba.2011.44-915

Vaz, P. C. M., Piazza, C. C., Stewart, V., Volkert, V. M., & Groff, R. A. (2012). Using a chaser to decrease packing in children with feeding disorders. *Journal of Applied Behavior Analysis, 45*(1), 97–105. https://doi.org/10.1901/jaba.2012.45-97

Volkert, V. M., & Piazza, C. C. (2012). Pediatric feeding disorders. In P. Sturmey & M. Hersen (Eds.), *Handbook of evidence-based practice in clinical psychology* (pp. 323–337). John Wiley & Sons. https://doi.org/10.1002/9781118156391.ebcp001013

Volkert, V. M., & Vaz, P. C. M. (2010). Recent studies on feeding problems in children with autism. *Journal of Applied Behavior Analysis, 43*, 155–159. https://doi.org/10.1901/jaba.2010.43-155

Volkert, V. M., Vaz, P. C. M., Piazza, C. C., Frese, J., & Barnett, L. (2011). Using a flipped spoon to decrease packing in children with feeding disorders. *Journal of Applied Behavior Analysis, 44*(3), 617–621. https://doi.org/10.1901/jaba.2011.44-617

Volkert, V. M., Piazza, C. C., Vaz, P. C. M., & Frese, J. (2013). A pilot study to increase chewing in children with feeding disorders. *Behavior Modification, 37*(3), 391–408. https://doi.org/10.1177/0145445512474295

Volkert, V. M., Peterson, K. M., Zeleny, J. R., & Piazza, C. C. (2014). A clinical protocol to increase chewing and assess mastication in children with feeding disorders. *Behavior Modification, 38*(5), 705–709. https://doi.org/10.1177/0145445514536575

Volkert, V. M., Piazza, C. C., & Ray-Price, R. (2016). Further manipulations in response effort or magnitude of an aversive consequence to increase self-feeding in children with feeding disorders. *Behavior Analysis in Practice, 29*, 573–575. https://doi.org/10.1007/s40617-016-0124-1

Vollmer, T. R., Sloman, K. N., & St. Peter Pipkin, C. (2008). Practical implications of data reliability and treatment integrity monitoring. *Behavior Analysis in Practice, 1*, 4–11. https://doi.org/10.1007/BF03391722

Whipple, H., Scherr, R., & Kozlowski, K. M. (2019). Simultaneous presentation to decrease packing in a child with a feeding disorder. *Behavior Analysis in Practice, 13*(1), 197–204. https://doi.org/10.1007/s40617-019-00360-7

Wilder, D. A., Normand, M., & Atwell, J. (2005). Noncontingent reinforcement as treatment for food refusal and associated self-injury. *Journal of Applied Behavior Analysis, 38*(4), 549–553. https://doi.org/10.1901/jaba.2005.132-04

Wilkins, J. W., Piazza, C. C., Groff, R. A., & Vaz, P. C. (2011). Chin prompt plus re-presentation as treatment for expulsion in children with feeding disorders. *Journal of Applied Behavior Analysis, 44*(3), 513–522. https://doi.org/10.1901/jaba.2011.44-513

World Health Organization. (2019). *International statistical classification of diseases and related health problems* (11th ed.). https://icd.who.int/

ADHD, Distractibility, and ABA

20

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Introduction

The clinical syndromes that we now refer to as autism spectrum disorder (ASD) and attention deficit/hyperactivity disorder (ADHD) have existed independent of each other for 250+ years. Rather surprisingly, it is only in the past several decades that the potential coexistence of ASD and ADHD in the same individual has been a consideration. As "*Jack*" in the clinical vignette above depicts, it is now relatively common for children with ASD to be diagnosed with comorbid ADHD.

"Jack"

Jack is a 9-year-old fourth grader who was diagnosed with high functioning autism spectrum disorder (ASD) at the age of 3 years by a developmental pediatrician. In addition to the core ASD symptoms, Jack's mother reports that Jack is often easily distracted by extraneous stimuli, avoids doing homework, and is impatient. She reported that these behaviors occur at home, school, and during soccer practice and are negatively impacting his academic and social functioning, above and beyond what Jack's mother considers to be the impact of Jack's ASD.

In his spare time, Jack enjoys watching YouTube. Jack is interested in social interactions yet often fails to engage in socially appropriate interactions with his peers. For example, Jack's mother reports that Jack has difficulties sustaining friendships and can be "too bossy." Jack's teacher describes Jack as "socially immature" and that he often engages in attention seeking behaviors. Academically, Jack's teacher describes Jack as bright and capable yet reported that Jack is academically below grade level in both reading and written expression. Jack is reported to be doing quite well in science, a subject in which Jack has great interest.

Jack has difficulties falling asleep and is described as a "restless" sleeper. His mother reported that Jack is also a "picky" eater and has great difficulties tolerating certain tactile sensations (e.g., Jack refused to wear socks unless the elastic band has been cut out of the socks). At home, Jack is easily frustrated and argues with his parents often. He has difficulty following routines and needs frequent reminders to complete his activities of daily living. At school, Jack is more cooperative yet gets reprimanded more frequently during unstructured times of his day (e.g., lunch, gym). Jack's teacher described him as forgetful and disorganized.

Jack's mother reported that although she initially perceived the above symptoms and concerns to be related to his ASD diagnosis, over the past several years she has become increasingly curious about the possibility that Jack may have comorbid attention deficit / hyperactivity disorder (ADHD). At the school's insistence, Jack's mother is now considering having him evaluated and possibly treated for ADHD.

Jack's father does not share her opinion and is less enthusiastic about having Jack evaluated and possibly treated for ADHD, stating, "I was just like Jack as a boy and I turned out fine."

After several months of continued discussions and conversations with Jack's pediatrician, Jack was referred to a developmental pediatrician for an ADHD evaluation. Following the comprehensive evaluation, Jack was diagnosed with ADHD-Combined presentation and prescribed an extended-release stimulant medication. Jack's parents were also referred to a local psychologist for behavioral parent training. After 6 months of this combined treatment approach, Jack's teacher believes that Jack is less forgetful and functioning closer to grade level in reading and written expression. Jack's parents report that Jack is less argumentative at home and easier to engage in tasks (e.g., homework) that he previously avoided. Despite these improvements in academic and family functioning, Jack's parents and teacher reported that Jack's strained social interactions continue to be an area of ongoing concern.

This chapter will provide the reader background information regarding ADHD, ASD and the comorbid state (ADHD+ASD) with a particular focus on differential diagnoses and treatments. It is assumed that the reader of an ABA textbook will have more familiarity with ASD than ADHD. Thus, coverage of these topics will be more detailed and descriptive about ADHD and ASD+ADHD.

ADHD

Diagnostic Criteria

ADHD is a neurodevelopmental disorder characterized by elevated and impairing symptoms of inattention and/or hyperactivity and impulsivity (American Psychiatric Association [APA], 2013). To meet *Diagnostic and Statistical Manual for Mental Disorders, 5th edition* (*DSM-5*) ADHD criteria, a child must have six or more inattentive symptoms and/or six or more hyperactive-impulsive symptoms that occur at least "often" for more than 6 months in two or more settings (e.g., school, home). Inattentive symptoms include disorganization, not being able to stay on task, not listening, and losing items. Hyperactive-impulsive symptoms include always being "on the go," fidgeting and squirming, having difficulty remaining seated, and being impatient. Three distinct *DSM-5 ADHD* presentations (formerly called subtypes) exist: predominantly inattentive, predominantly hyperactive-impulsive, and combined.

Additional *DSM-5* diagnostic criteria stipulate that several ADHD symptoms had to have onset before the age of 12 years and that another condition cannot better explain the ADHD symptoms and impairments (APA, 2013). It is this final *DSM-5* criterion (Criterion E) that will be of particular interest to readers of this chapter. Prior to the publication of the *DSM-5* in 2013, an ADHD diagnosis could not be assigned in individuals with ASD. Prior to the *DSM-5*, it was believed that an ASD diagnosis would explain the inattentive and/or hyperactive-impulsive symptoms better than ADHD (APA, 2013; Faraone et al., 2015; Joshi et al., 2017).

Prevalence/Etiology

ADHD prevalence rates have been increasing steadily over the past 40 years with prevalence rates reported to be as high as 11% for youth aged 4–17 years old (Visser et al., 2014). Potential reasons for this increase include increased awareness as well as several public policy changes in the United States over the last 40 years: federal special education law was changed to include ADHD as a qualifying condition in a category called, "Other Health Impaired," Medicaid was reauthorized and included ADHD as a condition which was reimbursable for provider evaluation and treatment, and Supplemental Security

Income (SSI) law was amended to include ADHD as a qualifying condition (Hinshaw, 2018). ADHD prevalence rates typically increase with age up until about age of 9 years and then begin to decline (Mohammadi et al., 2021).

ADHD prevalence is elevated among certain subsets of the population, namely males, children who are "young for grade" (born shortly after their local school cut-off birthdate), urban residents, and individuals with mothers who were previously hospitalized for psychiatric reasons (Mohammadi et al., 2021). ADHD is diagnosed 2–4 times more often in males than females. ADHD can present differently in females and as a result may be underdiagnosed in females. For example, females are more likely to present with inattentive symptoms and less overt disruptive behaviors than males, who more often present with higher hyperactivity-impulsivity levels (Franke et al., 2018).

ADHD is a highly heritable condition with heritability coefficients between 0.70 and 0.80 (Larsson et al., 2014). Maternal smoking and alcohol use during pregnancy, premature birth, low birth weight, and exposure to environmental toxins are environmental risk factors for ADHD (Scassellati et al., 2012). The combination of environmental and biological risk factors surpasses a certain ADHD threshold, leading to the development of impairing ADHD symptoms (Faraone et al., 2015).

Longitudinal Trajectories

As a neurodevelopmental disorder, ADHD is most commonly diagnosed in childhood. Diagnostic considerations (discussed below) must therefore be anchored in a developmental perspective which appreciates that inattentive and/or hyperactive/impulsive symptoms are common in typically developing children. Thus, to represent pathology, the ADHD symptoms must be a significant deviation from the levels of inattentive or hyperactive/impulsive symptoms that are typical of that age group. Impairing hyperactive-impulsive symptoms are most likely to rise to clinical attention first (during early to middle childhood), while impairing inattentive symptoms generally rise to clinical attention somewhat later (middle childhood to early adolescence). Similarly, hyperactive-impulsive symptoms generally remit earlier (in adolescence or young adulthood), while the inattentive symptoms persist across the lifespan (Franke et al., 2018). ADHD persists into adulthood often, with about two-thirds of children with ADHD continuing to experience elevated ADHD symptoms and impairments in adulthood (Faraone et al., 2006).

An ADHD diagnosis is associated with increased public health expenditures and reduced quality of life (Mohammadi et al., 2021). Similar to "*Jack*" in the vignette above, 25–40% of individuals with ADHD experience significant reading and writing difficulties (Franke et al., 2018). As a result, ADHD is associated with lower rates of attaining high-school diplomas or post-secondary degrees (Franke et al., 2018). Individuals with ADHD are at an increased risk for violent offending and incarceration in adolescence and adulthood (Franke et al., 2018). Individuals with ADHD also experience higher rates of unemployment and job turnover in adulthood (Franke et al., 2018). ADHD is also associated with higher mortality rates, mainly accidental, such as reckless driving or suicidal behavior (Franke et al., 2018) leading to a decreased life expectancy.

Children with ADHD frequently experience low levels of reciprocal friendship (Mikami et al., 2017). ADHD is associated with social impairments that continue into adulthood, such as higher rates of separation/divorce (Franke et al., 2018). Although emotion dysregulation is not an ADHD symptom, many youth with ADHD experience emotion dysregulation which can negatively impact social functioning beyond what is expected from core ADHD symptoms alone (Paulus et al., 2021).

Theoretical Model

Multiple theoretical models of ADHD have been developed to explain ADHD including theories related to dopamine dysregulation, altered reinforcement mechanisms, deficient response inhibition, and inefficient information processing.

The triple-pathway model (Sonuga-Barke et al., 2010) was developed as a way to reconcile these multiple extant theories and explain the considerable heterogeneity present in ADHD. The triple-pathway model considers ADHD to be the result of dysfunction in one, two, or three distinct biologically mediated pathways: the delay averse pathway (individuals with ADHD exhibit an aversion to waiting for rewards), the inhibitory control pathway (individuals with ADHD have difficulty suppressing behaviors or responses), and the temporal processing pathway (individuals with ADHD over-estimate time intervals). According to the Triple Pathway Theory, each of these three domains represents a unique neuropsychological deficit and etiological pathway to ADHD and helps to explain the substantial heterogeneity inherent to the disorder (Sonuga-Barke et al., 2010).

Environmental compounding and compensatory processes also contribute to the considerable heterogeneity that exists in ADHD (Sonuga-Barke et al., 2010). Environmental compounding refers to how constraints related to ADHD (e.g., inattentive symptoms) restrict opportunities for learning and skill development that, in turn, intensify existing cognitive and motivational problems. For example, a child with ADHD who has limited motivation for reading due to the sustained attention demands is likely to fall further behind their peers educationally due to limited opportunities for practice. On the other hand, compensatory processes refer to how ADHD-related constraints may stimulate gaining different skills and coping strategies that permit improved functioning. For example, an adolescent with ADHD who is disorganized may develop their own idiosyncratic organizational system which aids in improved functioning.

Comorbidities

Individuals with ADHD are at a high risk for having comorbid disorders, with 33–87% of children with ADHD having a comorbid disorder (Mohammadi et al., 2021). Anxiety, mood, learning, and disruptive behavior disorders (e.g., oppositional defiant disorder) are all common in children with ADHD (Austerman, 2015; Mohammadi et al., 2021). In adulthood, individuals with ADHD are at higher risk for developing a substance use disorder (Austerman, 2015). While less prevalent due to the lower base rate in the population, ASD is diagnosed in 13% of youth with ADHD (Zablotsky et al., 2017).

Given the high rates of comorbidities present in individuals with ADHD and the increased functional impairments associated with comorbid diagnoses, it is important to consider the potential impact of other diagnoses during ADHD assessment and treatment planning.

ASD

Diagnostic Criteria

ASD is a neurodevelopmental disorder characterized by social difficulties and restricted, repetitive, and stereotyped patterns of interests, behaviors, and activities (APA, 2013). ASD symptoms must cause impairment and cannot be better explained by intellectual disability or global developmental delay (APA, 2013). Unlike the social difficulties that may occur in individuals with ADHD, social difficulties are central to an ASD diagnosis and are generally more severe in individuals with ASD. For example, although children with ADHD may experience performance deficits in social interactions, children with ADHD have intact social knowledge. On the other hand, children with ASD are more likely to possess social knowledge deficits (Antshel & Russo, 2019).

Inattention, hyperactivity, and impulsivity are not characteristic phenotypic features of ASD. Nonetheless, impairing levels of inattention, hyperactivity, and/or impulsivity exist in 40–70% of youth with ASD (Joshi et al., 2014; Kaat et al., 2013; Salazar et al., 2015). These considerable rates of inattention, hyperactivity, and/or impulsivity in youth with ASD complicate ADHD diagnoses in the ASD population (Grzadzinski et al., 2016), a point which will be discussed in greater detail below.

Prevalence/Etiology

Similar to ADHD, ASD is increasing in prevalence with current estimates around 1% (Young et al., 2020b). Also similar to ADHD, ASD prevalence rates are higher among males than females; ASD is four times more common among males than females. Females with ASD may present differently than males with ASD and often present with milder restrictive and repetitive behaviors (Young et al., 2020b).

Similar to ADHD, ASD is highly heritable with 60–90% of the phenotype being accounted for by genetics. Also similar to ADHD, environmental exposures (e.g., herbicides, heavy metals) and prenatal alcohol/drug use increase the risk of an ASD diagnosis (Pugsley et al., 2021).

Longitudinal Trajectories

ASD symptoms typically onset before the age of 3 years as developmental delays and impairments in language and social skills (Young et al., 2020b). Similar to ADHD, ASD is associated with diverse functional impairments across the lifespan including impairments in educational, social, emotional, and occupational domains (Young et al., 2020b). Although these same domains are impaired in ADHD populations, there are important between-group qualitative and quantitative differences in the nature of these impairments, a topic described in greater detail below. For example, children with ASD tantrum and can negatively impact family functioning secondary to difficulties managing change. This same behavior (tantrum) and the associated negative impact upon the family in children with ADHD may be secondary to delay aversion/impatience (APA, 2013).

Comorbidities

Also similar to ADHD, comorbidity is common in ASD. The most common comorbid condition in individuals with ASD is ADHD (Antshel & Russo, 2019). Intellectual disabilities also occur more frequently among individuals with ASD than in the general population, at prevalence levels comparable to the rates of ADHD in ASD (Young et al., 2020b). Social anxiety disorder and oppositional defiant disorder are also common among individuals with ASD (Young et al., 2020b).

Comorbidity of ASD and ADHD

Comorbidity rates of ADHD in children with ASD range from 40% to 70% (Joshi et al., 2014, 2017; Kaat et al., 2013; Salazar et al., 2015), making ADHD the most common comorbidity with ASD. Similarly, ASD commonly occurs in ADHD, with approximately 1 in 8 children with ADHD having a comorbid ASD diagnosis (Kaat et al., 2013). In many cases where individuals do not meet threshold to be diagnosed with comorbid ASD+ADHD, there are often elevated symptoms of ADHD in children with ASD and vice versa (Grzadzinski et al., 2011). Thus, the high prevalence of ASD+ADHD and associated functional impairments warrant attention to the comorbid condition.

Theories of Comorbidity

Clearly, ASD and ADHD frequently co-occur, but why is there this high prevalence of comorbidity? ASD and ADHD are both neurodevelopment disorders that are highly heritable (Pettersson et al., 2019; Polderman et al., 2015), onset in childhood, and persist into adulthood (Hartman et al., 2016). Despite these similarities in heritability, onset, and course, the precise causal links between ASD and ADHD are currently unknown.

One of the most promising areas to explain the high rates of ASD+ADHD comorbidity is genetics. There are elevated rates of ADHD diagnoses in individuals with a family history of ASD (Ghirardi et al., 2018; Magallon-Neri et al., 2018; Septier et al., 2019) and vice versa (Jokiranta-

Olkoniemi et al., 2019). In twins, when only one twin is diagnosed with ASD, there is an increased likelihood that the other, unaffected twin will have elevated ADHD symptoms (Ghirardi et al., 2018). Siblings of individuals with ASD are four times more likely to be diagnosed with ADHD compared to matched controls (Jokiranta-Olkoniemi et al., 2016). Furthermore, genomic analysis studies have identified overlapping single nucleotide polymorphisms (Jansen et al., 2020; Peyre et al., 2021) and copy number variations (Elia et al., 2010), among those with ADHD and ASD. Taken together, this evidence suggests that ASD and ADHD have shared genetic heritability.

Because of the high prevalence of comorbidity and some shared symptomology and genetic overlap, arguments have been made that ASD and ADHD are variations in the same disorder. However, this claim is not supported by the existing literature. Rather than ASD and ADHD representing the same condition, there are currently three leading hypotheses with empirical support to understand comorbid ASD and ADHD (Antshel & Russo, 2019). These hypotheses are as follows: (1) ASD and ADHD are separate and distinct conditions and ASD+ADHD is a third separate condition ("the splitter hypothesis"); (2) comorbid ASD+ADHD is a subtype of ASD ("the subgroup hypothesis"); and (3) development of one condition increases risk for the other (the "potentiation hypothesis"). Although the exact mechanism driving the high prevalence of comorbid ASD+ADHD is not well understood, there is clear evidence to suggest that ASD and ADHD are similar, yet distinct disorders.

ASD+ADHD Presentation

As noted earlier in this chapter, the hallmark features of ADHD differ from those of ASD, yet there is some overlap in symptomology and associated features between the conditions. The comorbid ASD+ADHD presentation appears to be overall additive in nature, such that symptoms of both conditions compound in the comorbid presentation resulting in a more severe presentation accompanied by increased functional impairments. Please see Fig. 20.1 for a detailed overview of the phenotypic presentations of ADHD, ASD and ASD+ADHD.

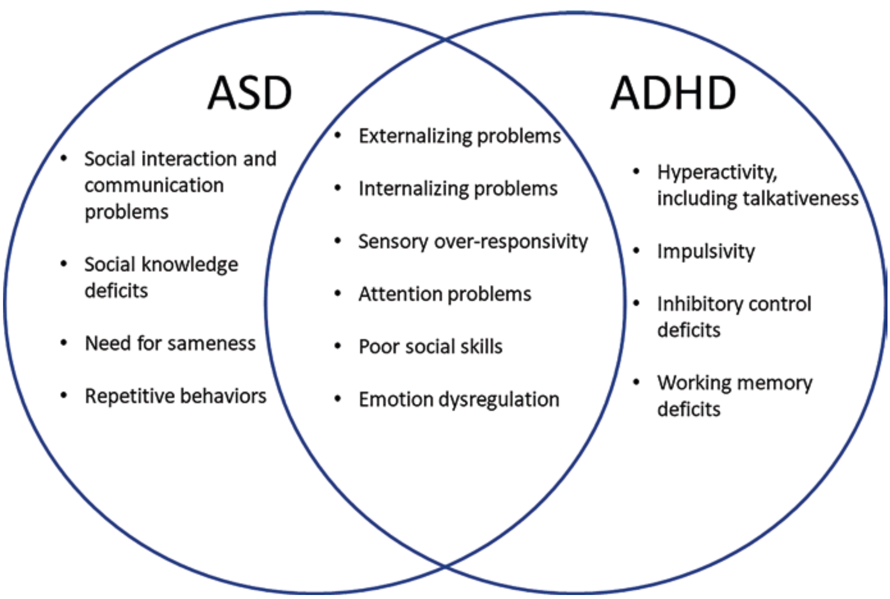

Fig. 20.1 ADHD and ASD

Mental Health and Executive Functioning

Internalizing symptoms (e.g., anxiety, depression) are common in both ASD and ADHD, and consistent with the additive profile, internalizing symptoms occur with greater frequency and severity in comorbid ASD+ADHD. Parents of children with ASD+ADHD report overall lower psychosocial functioning in their children relative to parents of children with ASD or ADHD alone or of typically developing (TD) children (Leader et al., 2021). Compared to children with ASD or ADHD alone, children with ASD + ADHD exhibit greater anxiety (Avni et al., 2018; Colombi & Ghaziuddin, 2017; Lecavalier et al., 2019) and more severe depressive symptoms (Jang et al., 2013). Moreover, in the comorbid condition internalizing symptom severity is associated with ASD severity, and externalizing symptom severity is associated with ADHD severity (Dellapiazza et al., 2021). This suggests that, in addition to the greater severity of internalizing symptoms in the comorbid condition, ADHD severity and ASD severity uniquely contribute to dimensions of the comorbid condition.

The executive function profile of ADHD shares some overlap with that of ASD (Karalunas et al., 2018), yet more pervasive and severe executive dysfunction is associated with ADHD compared to ASD (Bloemen et al., 2018). Similar to internalizing symptoms, there appears to be an additive nature to comorbid ASD+ADHD executive dysfunction (Antshel & Russo, 2019; Lukito et al., 2017), such that greater executive dysfunction is seen in ASD+ADHD compared to either disorder alone. Individuals with ASD+ADHD have notable impairments in cognitive flexibility, planning, and response inhibition (Antshel & Russo, 2019). Compared to youth with ADHD or ASD, those with ASD+ADHD demonstrate greater deficits on multiple response inhibition tasks and are particularly impaired in adjusting to task demands, filtering out incongruent information, and exhibit slower response time (Cremone-Caira et al., 2021). Similarly, greater working memory impairments are exhibited in youth with comorbid ASD+ADHD compared to ASD alone (Colombi & Ghaziuddin, 2017).

Taken as a whole, these findings indicate that comorbid ASD+ADHD has a mental health and executive function profile that reflects the profile of both ASD and ADHD. Consistent with the additive nature of the comorbid condition, internalizing symptoms and executive dysfunction are more frequent and severe in ASD+ADHD than either condition alone.

Behavioral

Similar to the additive nature of psychological impairment in comorbid ASD+ADHD, greater behavioral impairments are seen in ASD+ADHD. For example, stereotypy—common in ASD—is correlated strongly with hyperactive/impulsive symptoms (Ghirardi et al., 2019), and the presence of ADHD exacerbates the occurrence of stereotypic behavior in ASD (Leader et al., 2021). Likewise, externalizing behaviors (e.g., tantrums, physical aggression)—common in both ASD and ADHD—occur with greater frequency in the comorbid condition (Konst et al., 2013). Tantrum behavior, in particular, is more frequent and severe in ASD+ADHD relative to ASD or ADHD alone (Goldin et al., 2013; Konst et al., 2013). ADHD severity is associated with other challenging behaviors that are often present in ASD, such as feeding and sleep disturbances (Leader et al., 2021).

In addition to an increase in externalizing problems, youth with ASD+ADHD demonstrate less positive adaptive behaviors and lower functional independence levels than youth with either disorder alone (Ashwood et al., 2015). For their age, youth with ASD+ADHD have lower socialization, communication, and daily living skills (Rao & Landa, 2014; Scandurra et al., 2019; Yerys et al., 2019). This lack of adaptive socialization and communication skills may play a role in the heightened social impairments seen in youth with ASD+ADHD.

Social

Impairments in social functioning are a key area of overlap between ASD and ADHD, though there are differences in the nature of social impairment in the independent conditions. Although social deficits are not a diagnostic feature of ADHD and children with ADHD have intact social knowledge (Aduen et al., 2018), impaired social interactions are common in ADHD. The social impairments in ADHD are mainly due to deficits in social performance (Aduen et al., 2018) and the presence of impulsive behaviors, such as interrupting and intruding on conversations (Gardner & Gerdes, 2015).

Conversely, social impairment is a hallmark of ASD, and children with ASD lack social knowledge (Pedreno et al., 2017). Social difficulties in ASD appear to be more attributable to absence of positive, prosocial behaviors (e.g., social approach, eye contact) rather than the presence of negative or impulsive behaviors seen in ADHD (Locke et al., 2016). Compared to TD youth and youth with ASD, youth with ADHD exhibit intermediate impairments in social cognition (e.g., social cue recognition; Baribeau et al., 2015). However, hyperactivity symptoms in both groups negatively impact social perception (Baribeau et al., 2015), indicating that youth with comorbid ASD+ADHD may demonstrate especially impacted social perception difficulties. One implication of the difference in social knowledge between ASD and ADHD is children with ASD typically demonstrate greater improvements in clinic-based social skills training (Gates et al., 2017)—a point that will be further discussed below in the treatment section of this chapter.

Children with ASD and children with ADHD both experience difficulties in establishing and maintaining reciprocal peer relationships (de Boer & Pijl, 2016). Youth with ADHD are typically rated lower than TD peers on measures of peer regard (Ros & Graziano, 2018). Similarly, TD peers hold peers with ASD in lower regard are less willing to engage with peers with ASD (Sasson et al., 2017).

There is evidence to suggest greater social impairments in comorbid ASD+ADHD than in either of the single disorders. Compared to youth with a single ASD or ADHD diagnosis, those with ASD+ADHD exhibit greater difficulties in social relationships with siblings and peers (Dellapiazza et al., 2021) and maintaining interpersonal relationships (Leader et al., 2021; Scandurra et al., 2019). Youth with ASD+ADHD demonstrate less social awareness and social communication skills than those with ADHD only and are at least as impaired in social awareness and social communication that those with ASD only (Factor et al., 2017; Harkins et al., 2021; Rao & Landa, 2014). One study using an all-male sample found that boys with ASD+ADHD had less prosocial behaviors than boys with ASD (Yamawaki et al., 2020). Taken together, these findings suggest that the presence of ADHD-related social performance deficits appears to compound ASD-related social knowledge deficits. This results in more severe social impairments in the comorbid ASD+ADHD condition.

Assessment/Differential Diagnosis

ADHD Assessment

Assessment strategies for ADHD vary widely among providers, but current gold standard ADHD diagnostic processes include the following: (1) use of standardized ADHD rating scales and impairment measures completed by parents and teachers, (2) behavioral observations, and (3) semi-structured interviews with parents and children separately (Pelham et al., 2005). No neurological, genetic or neuropsychological tests have sufficient positive and negative predictive power to accurately classify ADHD with sufficient success to recommend them for clinical diagnosis (Pliszka, 2007). However, cognitive/neuropsychological assessment can be helpful to specify the phenotype, decipher some differential diagnoses, guide families, and provide valuable information for interventions (Molitor & Langberg, 2017).

Standardized rating scales often used in ADHD evaluation include narrow-band ADHD rating scales such as the Vanderbilt ADHD Diagnostic Rating Scale (VADRS) and ADHD Rating Scale, fifth edition (ADHD-RS-5) and broad band rating scales such as the Conners' Comprehensive (CBRS) and the Behavioral Assessment System for Children, third edition (BASC-3). Each of these scales has separate parent, teacher, and child report versions. As with any psychiatric diagnosis, rating scales should not be used in isolation to make a diagnosis. Specific to ADHD, use of these scales only provides 20% of the necessary information (*DSM-5* Criterion A) required to make an ADHD diagnosis.

In addition to standardized rating scales, ADHD evaluations also entail use of a semi-structured interview such as the Kiddie Schedule for Affective Disorders and Schizophrenia for School Age Children Present and Lifetime Version, fifth edition (K-SADS-PL-5). The KSADS-PL-5 can be used to screen for 52 disorders (including ASD) and generates reliable and valid ADHD diagnoses (Jarbin et al., 2017). Family history is also useful to collect in the interview process as ADHD (and ASD) is highly heritable and commonly occur in in first- and second-degree relatives.

ASD Assessment

Commonly used ASD diagnostic measures include the Autism-Diagnostic Interview, Revised (ADI-R; Lord et al., 1994) and the Autism Diagnostic Observation Schedule, 2nd edition (ADOS-2; Lord & Rutter, 2012). Both of these measures have good sensitivity and specificity toward an ASD diagnosis. The ADI-R is a standardized, semi-structured interview conducted with caregivers that assesses reciprocal social interaction, restricted and repetitive, stereotyped behaviors, and communication and language skills. The ADOS-2 is a play-based interactive assessment that measures communication, play/imagination, social interaction, and restricted/repetitive behaviors.

Rating scales can also be used in ASD diagnostic processes; some of the most frequently used scales include the Social Communication Questionnaire (SCQ), the Social Responsiveness Scale (SRS-2), and the Social and Communication Disorders Checklist (SCDC). These rating scales are not considered gold standard diagnostic tools and none of these tools should be used in isolation to make a diagnosis.

Discriminant Validity

Due to the high overlap between ADHD and ASD symptoms and the significant rate of comorbidity between the two conditions, it is important that clinicians use diagnostic processes designed to maximize discriminant validity. Fortunately, existing measures for ASD and ADHD assessments have solid discriminant validity potential. For example, the ADI-R and ADOS-2 both do an adequate job of differentiating between ADHD and ASD (Antshel & Russo, 2019). The K-SADS-PL can be also used to make a differential diagnosis between ADHD and ASD (Young et al., 2020b).

The Social Communication Questionnaire (SCQ) has been used to differentiate between individuals with ADHD, ASD, and comorbid ASD+ADHD (Antshel & Russo, 2019). Typically, individuals with ASD will report higher SCQ total and domain scores than individuals with ADHD, with a cut score of 13 differentiating between the two disorders (Antshel & Russo, 2019). Other rating scales suitable for use in differentiating between ASD and ADHD include the Strengths and Difficulties Questionnaire (SDQ) and the Development and Well-Being Assessment (DAWBA; Young et al., 2020b). The SDQ evaluates emotional, hyperactive, inattentive, conduct, antisocial, and dysfunctional peer relationship symptoms. The DAWBA is a package of questionnaires that can be utilized to generate various psychiatric disorders. Therefore, administering any of the above rating scales as part of the diagnostic evaluation could aid in making a differential diagnosis.

While not a standard component of ADHD or ASD diagnostic evaluations, assessing executive functioning can aid in differentiating the two conditions. Although individuals with ADHD and ASD both experience executive functioning deficits, individuals with ADHD more often experience difficulties with inhibition (withholding a prepotent response) and planning/problem solving (Antshel & Russo, 2019). Individuals with ASD, on the other hand, experience the most difficulties with cognitive flexibility, defined as the ability to hold and quickly switch between various perspectives (Antshel & Russo, 2019). Overall, executive functioning is more impaired in individuals with ADHD and these impairments are less likely to improve in age compared to those with ASD (Antshel & Russo, 2019). Therefore, measures that examine executive functioning may assist in making a differential diagnosis between ADHD and ASD but should never be used in isolation to arrive at a diagnosis.

In sum, ADHD and ASD display similar symptoms and are often comorbid. Thus, making a differential diagnosis requires the use of diagnostic tools with adequate discriminant validity. Collecting a thorough developmental and family history, using standardized broad- and narrow-band rating scales and semi-structured interviews, and assessing executive functioning can be helpful in differentiating between ADHD, ASD, and comorbid ASD+ADHD.

ADHD and ASD+ADHD Treatment

As outlined above, comorbid ASD+ADHD is associated with a differing, and potentially more severe, profile of symptoms and impairments than both ADHD or ASD in isolation. Thus, treatments for comorbid ASD+ADHD often need to address symptoms related to both disorders, including attentional difficulties, executive dysfunction, social impairment, and challenging behaviors.

This section will serve to review the most effective treatments for ADHD and when data have been published, a focus on the efficacy of those ADHD treatments in the comorbid ASD+ADHD condition.

Medication

Although no medications are US Food and Drug Administration (FDA)-approved for treating the core symptoms of ASD, the FDA has approved the use of stimulants, atomoxetine, and alpha-2 agonist (e.g., guanfacine) medications for managing ADHD symptoms (Caye et al., 2019). Stimulant medications, including methylphenidate and amphetamine compounds, have been considered the first-line pharmacological treatment for children and adolescents with ADHD for more than 60 years. Stimulant medication is the most common mode of ADHD treatment throughout the lifespan with approximately 70% of individuals with ADHD reporting reductions in core symptoms in response to stimulants (Gadoth, 2013).

Accordingly, 86% of youth with ASD+ADHD have been treated with psychotropic prescription medication for managing ADHD symptoms (Kilincaslan et al., 2016). The two most common target symptoms for psychotropic medication in ASD+ADHD are aggression and hyperactivity/impulsivity (Yamamuro et al., 2017).

Psychotropic medications prescribed for ADHD management in youth with ASD+ADHD are efficacious in reducing core ADHD symptoms but have no effect on core ASD symptoms. Youth with ASD+ADHD demonstrate reductions in hyperactivity/impulsivity symptoms when treated with methylphenidate (Kim et al., 2017; Reichow et al., 2013; Sturman et al., 2017). At the same time, stimulants are not as efficacious in treating ASD+ADHD as treating ADHD alone (Faraone & Buitelaar, 2010). Importantly, methylphenidate is associated with higher rates of side effects, such as social withdrawal, depression, and irritability, when used in comorbid ASD+ADHD (Reichow et al., 2013). Methylphenidate is considered to be the frontline treatment for managing ADHD symptoms in ASD+ADHD, though atomoxetine (Politte et al., 2018) and guanfacine (Kilincaslan et al., 2016) also demonstrate efficacy in treating ADHD symptoms in ASD+ADHD.

Behavioral Parent Training

Behavioral parent training (BPT) programs are typically multiweek programs that teach parents skills to manage disruptive child behaviors, often through direct instruction in core ABA principles. BPT for ASD alone will be discussed at length in Chap. 23. Thus, this section only seeks to provide an overview of the efficacy of BPT for ADHD, along with BPT considerations specific to comorbid ASD+ADHD.

Many efficacious BPT programs exist for parents of children with ADHD. These programs typically provide psychoeducation and teach strategies for managing disruptive child behavior. The two most commonly used BPT programs for children with ADHD are the Incredible Years and the Triple P—Positive Parenting Program (Austerman, 2015). The Incredible Years focuses on creating opportunities for active parent involvement through reinforcement of positive behaviors, setting clear boundaries, and teaching skills. Triple P is an early intervention program that promotes positive child–parent relationships to reduce behavioral issues.

Externalizing behaviors (e.g., tantrums, yelling, aggression, and noncompliance) are common target behaviors of concern to parents (Weber et al., 2019). BPTs for ADHD, such as Incredible Years and Triple P, are efficacious in reducing these externalizing behaviors, as well as increasing parenting self-efficacy and reducing parenting stress (Ciesielski et al., 2020; Gerdes et al., 2012; Loren et al., 2015). Importantly though, BPTs for ADHD do not demonstrate efficacy in reducing core ADHD symptoms (van den Hoofdakker et al., 2007) but rather target the associated externalizing symptoms that often accompany ADHD symptoms.

BPTs have been developed for ADHD and ASD in isolation and have demonstrated efficacy in ASD alone (Postorino et al., 2017) and ADHD alone (Ciesielski et al., 2020; Gerdes et al., 2012; Loren et al., 2015). However, there is limited research available about the efficacy of these diagnosis-specific programs in comorbid ASD+ADHD. One of the very few studies that considered this topic reported that the presence of ADHD moderated the effects of an ASD-specific parent training in children with ASD; the ASD-specific BPT was less efficacious for children with elevated ADHD symptoms (Lecavalier et al., 2017). Given that this is presently the only study to investigate BPT in ASD+ADHD, future research should continue to explore possible modifications or enhancements that may be made to existing BPTs to improve treatment efficacy in the comorbid condition.

Social Skills

Even though medication is the most widely used treatment for ADHD symptoms in the context of ASD, a combination of medication and psychosocial interventions is recommended for managing ADHD in the context of ASD (Mahajan et al., 2012). As described in Chap. 11, social skills are a primary deficit in ASD, and clinic- and school-based social skills training is efficacious in ASD alone (Gates et al., 2017). However, clinic- and school-based social skills training lack an evidence base suggesting efficacy in both youth with ADHD alone (Mikami et al., 2017) and comorbid ASD+ADHD (Antshel et al., 2011; Deckers et al., 2016). Based on this evidence, clinic- and school-based social skills training would not be recommended for ASD+ADHD. As noted above, the social difficulties in individuals with ADHD are more related to performance deficits, not knowledge deficits. Thus, social interventions for ADHD (and likely comorbid ASD+ADHD) need to be "point of performance" interventions that target the child in their natural environment.

Applied Behavior Analysis

While not always termed, ABA, behavior therapy is a common nonpharmacological treatment for youth with ADHD. Applications based upon the principles of ABA are effective in youth with ADHD (Daley et al., 2014). As is true for ABA in ASD, functional behavior analysis is a key assessment tool to identify target behaviors and relevant environmental factors (e.g., antecedents and consequences that respectively precipitate and maintain the target behavior) in order to create a behavior management plan for youth with ADHD (Pfiffner & Haack, 2014). For youth with ADHD, target behaviors to reduce are typically those that contribute to everyday functional impairment, and target behaviors to increase are adaptive, functional behaviors. Target behaviors to be reduced in treatment sometimes directly map onto core ADHD symptoms, especially in the hyperactivity/impulsivity domain (Pelham et al., 2005).

Once target behaviors are identified, ADHD-specific considerations for contingency management could be incorporated into behavior plans. Youth with ADHD demonstrate differences in motivational learning (Smith & Langberg, 2018), heightened delay discounting (e.g., preference for smaller, immediate rewards; Patros et al., 2016) and delay aversion (e.g., disinclination toward waiting; Patros et al., 2016), each of which can affect extinction of disruptive behaviors and learning of new, adaptive behaviors. Given the preference for immediacy of rewards and aversion to delayed reward, youth with ADHD demonstrate poorer performance and slower learning of behaviors under partial reinforcement schedules and have greater difficulties applying learned knowledge to new situations (e.g., generalization) without explicit reinforcement (Luman et al., 2021; Sali et al., 2018). As such, it is recommended to use immediate and continuous reinforcement when teaching new behaviors and to be particularly slow and careful when gradually fading reinforcement (van der Oord & Tripp, 2020).

The use of response-specific reinforcement may be effective in fostering situation-specific stimulus–response associations in youth with ADHD (van der Oord & Tripp, 2020). Moreover, youth with ADHD have impaired reward-predicting cues (Luman et al., 2021; Sali et al., 2018), leading to impaired acquisition of conditioned reinforcers and poorer stimulus control. Related to differences in reward learning, youth with ADHD are less responsive and more frustrated by negative punishment (e.g., response costs) for off-task or disruptive behavior compared to TD youth (Luman et al., 2009). Sparing and careful implementation of response costs in youth with ADHD is thus advised.

Recommendations to maximize stimulus control and salience of reinforcement for adaptive behaviors in youth with ADHD include the following: (1) explicitly and clearly explain the behavior-consequence relationship when establishing and administering reinforcement; (2) increase salience of discriminative stimuli, especially if delay is involved; (3) limit incidental or unintentional reinforcement and distraction; and (4) provide prompts and reminders for adaptive behavior when fading reinforcement after behavior acquisition (van der Oord & Tripp, 2020). Nonetheless, it is important to note that despite the intuitive appeal and high face validity of these modifications, to date, no research has considered how best to adapt ABA for youth with ASD+ADHD. Thus, these recommendations represent plausible ideas to consider rather than evidence-based considerations.

Other Treatment Considerations

Treatment recommendations for ADHD, ASD, and ASD+ADHD vary according to age, and the developmental level and specific concerns of the child should be considered when choosing interventions. Interventions for school-aged children may focus on developing academic, adaptive, and social skills in the child and contingency management training for parents and teachers (Antshel & Russo, 2019). In-school interventions, such as those provided under the umbrella of an Individualized Education Program (IEP), are commonly recommended and beneficial to school-aged children with ADHD and ASD (Austerman, 2015). Interventions for adolescents and adults with ADHD may utilize cognitive-behavioral therapy (CBT; Antshel & Russo, 2019) to reduce core ADHD symptoms and emotional symptoms and increase functional outcomes. In adulthood, there may be a larger focus on interventions that develop vocational and adaptive living skills for individuals with ADHD, ASD, and ASD+ADHD (Antshel & Russo, 2019). Thus, to be maximally effective, individual treatment plans should consider the individual's developmental level and functional expectations.

Future Directions

As delineated above, there is a rapidly growing body of research describing youth with comorbid ASD+ADHD. Nonetheless, there is appreciable heterogeneity in the comorbid condition that warrants further research on the presentation of, and effective treatments for, ASD+ADHD. Here, we highlight several potential directions in which the research and field may consider as a way of improving our understanding of the diagnostic complexities and treatment challenges present in comorbid ASD+ADHD.

Integrated Primary Care

Integrated primary care refers to the collaboration between primary care providers (PCPs) and mental health specialists on identification and treatment of mental health concerns. Integrated primary care is a favorable option to many PCPs as it is expected to enhance identification and monitoring of mental health symptoms and streamline referral pathways to specialty mental health care services (Petts & Gaynor, 2021; Stadnick et al., 2020).

The integrated care model may serve as a way to improve the delivery of evidence-based diagnostic practices and interventions for youth with comorbid ASD+ADHD. Pediatricians are often tasked with diagnosing and treating neurodevelopmental disorders, yet many PCPs express difficulties in diagnosing and treating neurodevelopmental disorders due to a lack of education on these disorders and difficulties in finding an appropriate mental health care provider to refer (Mazurek et al., 2020). While not investigated in ASD+ADHD, integrated primary care reduces waitlist time for ASD evaluations (Hine et al., 2020) and may enhance treatment outcomes in youth with ADHD (Shahidullah et al., 2018).

Importantly, there are significant potential difficulties in appropriately diagnosing and treating ASD+ADHD in the primary care setting, such as time constraints, less expertise and knowledge of the comorbid condition, and lack of thorough psychological assessment and streamlined process for referring patients to behavioral or psychotherapy services (French et al., 2019; Morris et al., 2019). Future studies could continue to establish the efficacy of different integrated primary care models in diagnosing and treating all neurodevelopmental disorders, but especially comorbid ASD+ADHD. Trials of integrated care models could assess both access to mental health services and treatment outcomes (i.e., global improvement and symptoms outcomes) to evaluate the efficacy of integrated primary care interventions. A focus on continued education and collaboration with mental health professionals in integrated care models may serve to increase the knowledge of neurodevelopmental disorders—especially comorbid ASD+ADHD—for PCPs.

School-Based Interventions

School-based interventions for ADHD and ASD have demonstrated promising results. Because youth spend the majority of their waking day in school, school-based interventions may serve to seamlessly deliver behavioral interventions in the natural environment, as opposed to in a clinic. For youth with ADHD, a 12-week school-based psychosocial intervention demonstrated a reduction in disruptive classroom behavior and improvements in academic and organizational skills (Pfiffner et al., 2016, 2018). Briefly, the intervention consisted of child individual and group sessions during the school day and parent training sessions intended to help parents manage child behavior, improve homework completion, and increase child independence at home. The in-school child sessions included modules of independence, social functioning, and homework and academic skills and utilized a reward-based contingency management program to reinforce new skills and manage child behavior (Pfiffner et al., 2016, 2018). Similarly, an 8-week school-based intervention using mindfulness techniques yielded improvements in response inhibition and attention for youth with ASD (Juliano et al., 2020). These initial findings indicate that although presently unexplored empirically, school-based interventions may be efficacious treatment methods to treat youth with ASD+ADHD. These school-based interventions are likely most effective when individualized and the intervention providers are skilled, experienced, and adaptable to the needs of the child (Young et al., 2020b).

Technology in Assessment/Treatment

Technological advances are omnipresent in society and are widely being utilized in novel ways for mental health assessments and treatments. Recently, the COVID-19 Pandemic required new technological adaptations to be created and deployed quickly to allow for contactless assessments and treatments. It is quite likely that some technological platforms developed during the pandemic will remain in use post-pandemic. Technological tools may help to reduce the impact of mental health stigma and are more accessible to people who may have difficulties attending in-person diagnostic evaluations and/or treatment due to scheduling difficulties, difficulties with face-to-face social interactions, or lack of transportation. Due to the social difficulties faced by individuals with ASD and scheduling difficulties faced by individuals with ADHD, web-based assessments and interventions may be particularly useful for individuals with ADHD, ASD, and comorbid ASD+ADHD by reducing face-to-face interactions and time commitment involved in traveling to an in-person meeting (Sehlin et al., 2018).

Eye-tracking technology represents an assessment consideration. In a study using, single-case comparison design, eye-tracking data differed between a child with ASD, a child with comorbid ASD+ADHD, and a neurotypical control child, while they viewed videos of social scenarios (Tsang & Chu, 2018). The child with comorbid ASD+ADHD had shorter durations of visual attention to social stimuli than the child with ASD and the neurotypical child. The child with ASD performed the fewest scans of social stimuli. Although the generalizability of this study is severely limited by the sample size, the findings indicate that eye-tracking assessment might be useful in differentiating between ASD, ADHD, and comorbid ASD+ADHD; however, more research with much larger and diverse samples is needed for support. Eye-tracking combined with a continuous performance test in ADHD assessment has solid abilities to discriminate between those with ADHD and controls (Lev et al., 2020). Future research could consider the extent to which eye-tracking aids the diagnosis of ADHD in youth with ASD, a much more difficult differential diagnosis than ADHD versus control.

Eye-tracking is also being considered in treatments for individuals with ASD and ADHD. For example, RECOGNeyes is a game that was developed with the aim of providing therapeutic benefits for children with ADHD (García-Baos et al., 2019). This game functions so that the player uses their eyes as a controller with the aim of training visual attention in the players. After the intervention was completed, participants demonstrated improvements in fixation gaze control, impulsivity, and reaction time, while children in the control condition that played the game with a mouse did not. This study provides some evidence that eye-tracking interventions can be useful for children with ADHD (García-Baos et al., 2019). Future research could consider the extent to which eye-tracking can also be utilized in ASD+ADHD interventions.

Web-based interventions have been found to be effective in reducing symptoms for individuals with neurodevelopmental disorders (Khan et al., 2019). However, few studies have examined the effectiveness of web-based interventions and more research is needed to determine if these effects are generalizable among large, diverse samples (Khan et al., 2019). Web-based interventions exist in various formats such as web-based CBT interventions, virtual environments with playable games, videoconferencing, and serious games (Khan et al., 2019). Some web-based interventions are therapist-assisted, in which the client receives treatment directly from a therapist in real-time, and others involve little client-therapist interaction.

Although web-based interventions can be utilized to make treatments more accessible, one limitation of web-based interventions is the occurrence of technological difficulties. Technical difficulties can arise in web-based interventions due to connection issues, not correctly following directions, faulty equipment, etc. Overall, web-based interventions seem like a promising novel way to make interventions more widely available, but more research needs to be conducted to determine the effectiveness of these interventions.

Technology is quickly advancing and novel tools for assessments and interventions are being developed and tested. While these technological advances may provide benefits such as increased access for clients, the ability to participate from home, and the ability to uncover behaviors that cannot be detected reliably by humans, it is important to note that these technologies are new and more research needs to be conducted to get a better understanding of the strengths and limitations of each. Additionally, technological issues will need to be addressed (e.g., access to someone who will be able to troubleshoot the problem, available resources for the person utilizing the tool to attempt to resolve the issue themselves). Finally, while technology increases accessibility for many individuals, technology may disproportionately impact lower-income individuals who may not have access to an internet connection or a laptop. All these benefits and drawbacks must be considered when considering whether technological assessments or interventions are appropriate.

ADHD and ASD in Females

Females with ADHD and ASD have been historically underrepresented in research and clinical practice, and in recent years, there has been a growing focus on increasing our understanding of ADHD and ASD in females (Gould, 2017; Young et al., 2020a). There is a greater prevalence of ADHD (Danielson et al., 2018) and ASD (Loomes et al., 2017) in males compared to females, with sex ratios estimates varying between 2:1 to 4:1 for both disorders; however, as noted above, these sex ratios may be overestimated given the evidence for under-recognition of these neurodevelopmental disorders in females. Research suggests that this under-recognition of ADHD and ASD stems from pervasive stereotypes that the disorders are more common in males and a lack of understanding the presentation of ADHD and ASD symptoms in females. Consequently, parents and teachers have greater difficulty identifying symptoms of these neurodevelopmental disorders in females (Groenewald et al., 2009; Whitlock et al., 2020). Females with ADHD and ASD are more likely to be misdiagnosed or receive a delayed diagnosis of ADHD or ASD compared to males with the same symptoms (Aggarwal & Angus, 2015; Mowlem et al., 2019). These missed or delayed diagnoses may lead to undertreatment of ADHD and ASD in females and may be particularly detrimental given the myriad of functional impairments for females in both disorders.

There are several commonalities of ADHD and ASD in females. Females with ADHD and ASD exhibit greater emotional dysregulation, internalizing symptoms (Mowlem et al., 2019; Young et al., 2018) and comorbidities with internalizing and eating disorders (Rynkiewicz et al., 2019; Soendergaard et al., 2016) compared to males with the same disorder. For both ADHD and ASD, to be diagnosed with either disorder females require more severe levels of symptoms, suggesting that clinicians may have a higher threshold for diagnosing ADHD and ASD in females (Aggarwal & Angus, 2015; Mowlem et al., 2019). Although adolescent females with ASD appear to "mask" social deficits by maintaining close physical proximity with peers, they display difficulties in engaging in activities with peers (Dean et al., 2017). This nuanced presentation of social deficits in females with ASD may lead teachers and parents to miss the identification and not seek out intervention for social difficulties in females, which may be particularly detrimental given the increased salience of friendships during adolescence. Similarly, females with ADHD begin to demonstrate greater deficits in social and communication skills compared to males with ADHD during adolescence despite having comparable levels of social skills during childhood (Mahendiran, 2019). Parents and teachers may miss these emerging social deficits at this socially sensitive developmental period due to a lack of previous social impairments. Finally, parents of females with ADHD and ASD express greater concerns about sex-specific puberty issues and socialization with other females compared to parents of TD females (Fei et al., 2021; Mademtzi et al., 2018).

Despite these female-specific concerns, the current treatments for ADHD and ASD have been studied in primarily male samples and do not address these female-specific issues (Gould, 2017; Young et al., 2020b). Given that females with these neurodevelopmental disorders experience greater social difficulties symptoms (Mahendiran, 2019), emotional dysregulation (Mowlem et al., 2019; Young et al., 2018), comorbid internalizing and eating disorders (Rynkiewicz et al., 2019; Soendergaard et al., 2016), and are at risk for significant impairments in adulthood (Gould, 2017; Young et al., 2020a), greater attention should be paid to treating this underrepresented group. Specifically, clinicians should be aware of potential gender biases when making diagnoses of neurodevelopmental disorders in females. Future research should continue to identify female-specific presentations and concerns in ADHD and ASD, and greater psychoeducation about these female-specific factors is needed to improve parent, teacher, and clinician identification of neurodevelopmental disorders in females. Finally, treatment plans for females with ADHD and ASD could attend to the need to address further the emotional dysregulation, internalizing symptoms, and peer difficulties in females.

Conclusion

"Jack," the child depicted in the vignette above, is a child with ASD+ADHD. ADHD is defined by impairing symptoms of inattention and/or hyperactivity-impulsivity that begin before the age of 12 years, are present in two or more settings and cannot be better explained by another condition (e.g., anxiety). The *DSM-5* includes three ADHD presentations: predominantly inattentive, predominantly hyperactive-impulsive, and combined. While most children with ADHD will not retain their full ADHD diagnosis into adulthood, the majority of these children will demonstrate impairing ADHD symptoms in adulthood. In both clinically referred samples and population studies, ADHD is more prevalent in males.

In children and adolescents, the ADHD diagnostic process typically involves a clinical interview with the child and parents as well as obtaining collateral information from teacher(s). No neurological, genetic, neuropsychological, or behavioral tests have sufficient positive and negative predictive power to accurately classify ADHD with sufficient success to recommend them for clinical diagnosis. ADHD is a clinically diagnosed condition that relies upon the expert knowledge of the clinician in the differential diagnosis among childhood mental disorders. Most youth with ADHD will meet criteria for another *DSM-5* psychiatric condition. The most common comorbidities include oppositional defiant disorder/conduct disorder, learning disorders, anxiety disorders, and mood disorders. The high prevalence of comorbid conditions complicates the diagnostic process as symptoms of inattention and hyperactivity are common to many of these comorbid conditions (e.g., anxiety, mood disorders).

ADHD is a very common comorbid condition in ASD. Due to the high overlap between ADHD and ASD symptoms and the significant rate of comorbidity between the two conditions, it is important that ASD and ADHD clinicians both use diagnostic processes designed to maximize discriminant validity. Fortunately, the most frequently used measures for ASD and ADHD assessments have solid discriminant validity potential.

The comorbid ASD+ADHD presentation appears to be overall additive in nature, such that symptoms of both conditions compound in the comorbid presentation resulting in a more severe presentation accompanied by increased functional impairments. Thus, treatments for comorbid ASD+ADHD often need to address symptoms related to both disorders, including attentional difficulties, executive dysfunction, social impairment, and challenging behaviors. Although no medications are FDA-approved for treating the core symptoms of ASD, the FDA has approved the use of stimulants, atomoxetine, and alpha-2 agonist (e.g., guanfacine) medications for managing ADHD symptoms. The vast majority of youth with ASD+ADHD have been treated with psychotropic prescription medication for managing ADHD symptoms. While stimulants are efficacious in ASD+ADHD, the effects are less robust and associated with higher rates of side effects, such as social withdrawal, depression, and irritability. BPT programs have efficacy in both ASD and ADHD and pending continued documented efficacy will likely prove beneficial in ASD + ADHD. Future research should continue to explore possible modifications or enhancements that may be made to existing BPTs to improve treatment efficacy in the comorbid condition.

In regards to potential future directions, further research considering ways of improving our understanding of the diagnostic complexities and treatment challenges present in comorbid ASD+ADHD is essential. Additionally, research in integrated primary care delivery models, school-based intervention delivery, use of technology in assessment and treatment as well as better understanding ASD+ADHD in females are priorities.

References

Aduen, P. A., Day, T. N., Kofler, M. J., Harmon, S. L., Wells, E. L., & Sarver, D. E. (2018). Social problems in ADHD: Is it a skills acquisition or performance problem? *Journal of Psychopathology and Behavioral Assessment, 40*(3), 440–451. https://doi.org/10.1007/s10862-018-9649-7

Aggarwal, S., & Angus, B. (2015). Misdiagnosis versus missed diagnosis: Diagnosing autism spectrum disorder in adolescents. *Australasian Psychiatry, 23*(2), 120–123. https://doi.org/10.1177/1039856214568214

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders. In *In* (5th ed.).

Antshel, K. M., & Russo, N. (2019). Autism spectrum disorders and ADHD: Overlapping phenomenology, diagnostic issues, and treatment considerations. *Current Psychiatry Reports, 21*(5), 34. https://doi.org/10.1007/s11920-019-1020-5

Antshel, K. M., Polacek, C., McMahon, M., Dygert, K., Spenceley, L., Dygert, L., Miller, L., & Faisal, F. (2011). Comorbid ADHD and anxiety affect social skills group intervention treatment efficacy in children with autism spectrum disorders. *Journal of Developmental and Behavioral Pediatrics, 32*(6), 439. https://doi.org/10.1097/DBP.0b013e318222355d

Ashwood, K. L., Tye, C., Azadi, B., Cartwright, S., Asherson, P., & Bolton, P. (2015). Brief report: Adaptive functioning in children with ASD, ADHD and ASD + ADHD. *Journal of Autism and Developmental Disorders, 45*(7), 2235–2242. https://doi.org/10.1007/s10803-014-2352-y

Austerman, J. (2015). ADHD and behavioral disorders: Assessment, management, and an update from DSM-5. *Cleveland Clinic Journal of Medicine, 82*(11 Suppl 1), S2–S7. https://doi.org/10.3949/ccjm.82.s1.01

Avni, E., Ben-Itzchak, E., & Zachor, D. A. (2018). The presence of comorbid ADHD and anxiety symptoms in autism spectrum disorder: Clinical presentation and predictors. *Frontiers in Psychiatry, 9*, 717. https://doi.org/10.3389/fpsyt.2018.00717

Baribeau, D. A., Doyle-Thomas, K. A., Dupuis, A., Iaboni, A., Crosbie, J., McGinn, H., et al. (2015). Examining and comparing social perception abilities across childhood-onset neurodevelopmental disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 54*(6), 479–486.e471. https://doi.org/10.1016/j.jaac.2015.03.016

Bloemen, A. J. P., Oldehinkel, A. J., Laceulle, O. M., Ormel, J., Rommelse, N. N. J., & Hartman, C. A. (2018). The association between executive functioning and psychopathology: General or specific? *Psychological Medicine, 48*(11), 1787–1794. https://doi.org/10.1017/S0033291717003269

Caye, A., Swanson, J. M., Coghill, D., & Rohde, L. A. (2019). Treatment strategies for ADHD: An evidence-based guide to select optimal treatment. *Molecular Psychiatry, 24*(3), 390–408. https://doi.org/10.1038/s41380-018-0116-3

Ciesielski, H. A., Loren, R. E. A., & Tamm, L. (2020). Behavioral parent training for ADHD reduces situational severity of child noncompliance and related parental stress. *Journal of Attention Disorders, 24*(5), 758–767. https://doi.org/10.1177/1087054719843181

Colombi, C., & Ghaziuddin, M. (2017). Neuropsychological characteristics of children with mixed autism and ADHD. *Autism Research and Treatment, 2017*, 5781781. https://doi.org/10.1155/2017/5781781

Cremone-Caira, A., Trier, K., Sanchez, V., Kohn, B., Gilbert, R., & Faja, S. (2021). Inhibition in developmental disorders: A comparison of inhibition profiles between children with autism spectrum disorder, attention-deficit/hyperactivity disorder, and comorbid symptom presentation. *Autism, 25*(1), 227–243. https://doi.org/10.1177/1362361320955107 de Boer, A., & Pijl, S. J. (2016). The acceptance and rejection of peers with ADHD and ASD in general secondary education. *The Journal of Educational Research, 109*(3), 325–332. https://doi.org/10.1080/00220671.2014.958812

Daley, D., van der Oord, S., Ferrin, M., Danckaerts, M., Doepfner, M., Cortese, S., et al. (2014). Behavioral interventions in attention-deficit/hyperactivity disorder: A meta-analysis of randomized controlled trials across multiple outcome domains. *Journal of the American Academy of Child and Adolescent Psychiatry, 53*(8), 835–847, 847.e831–835. https://doi.org/10.1016/j.jaac.2014.05.013

Danielson, M. L., Bitsko, R. H., Ghandour, R. M., Holbrook, J. R., Kogan, M. D., & Blumberg, S. J. (2018). Prevalence of parent-reported ADHD diagnosis and associated treatment among U.S. children and adolescents, 2016. *Journal of Clinical Child & Adolescent Psychology, 47*(2), 199–212. https://doi.org/10.1080/15374416.2017.1417860

Dean, M., Harwood, R., & Kasari, C. (2017). The art of camouflage: Gender differences in the social behaviors of girls and boys with autism spectrum disorder. *Autism, 21*(6), 678–689. https://doi.org/10.1177/1362361316671845

Deckers, A., Muris, P., Roelofs, J., & Arntz, A. (2016). A group-administered social skills training for 8- to 12-year-old, high-functioning children with autism spectrum disorders: An evaluation of its effectiveness in a naturalistic outpatient treatment setting. *Journal of Autism and Developmental Disorders, 46*(11), 3493–3504. https://doi.org/10.1007/s10803-016-2887-1

Dellapiazza, F., Audras-Torrent, L., Michelon, C., & Baghdadli, A. (2021). Clinical characteristics of children with ASD and comorbid ADHD: Association with social impairment and externalizing and internalizing behaviours. *Research in Developmental Disabilities, 113*, 103930. https://doi.org/10.1016/j.ridd.2021.103930

Elia, J., Gai, X., Xie, H. M., Perin, J. C., Geiger, E., Glessner, J. T., et al. (2010). Rare structural variants found in attention-deficit hyperactivity disorder are preferentially associated with neurodevelopmental genes. *Molecular Psychiatry, 15*(6), 637–646. https://doi.org/10.1038/mp.2009.57

Factor, R. S., Ryan, S. M., Farley, J. P., Ollendick, T. H., & Scarpa, A. (2017). Does the presence of anxiety and ADHD symptoms add to social impairment in children with autism spectrum disorder? *Journal of Autism and Developmental Disorders, 47*(4), 1122–1134. https://doi.org/10.1007/s10803-016-3025-9

Faraone, S. V., & Buitelaar, J. (2010). Comparing the efficacy of stimulants for ADHD in children and adolescents using meta-analysis. *European Child & Adolescent Psychiatry, 19*(4), 353–364. https://doi.org/10.1007/s00787-009-0054-3

Faraone, S. V., Biederman, J., & Mick, E. (2006). The age-dependent decline of attention deficit hyperactivity disorder: A meta-analysis of follow-up studies. *Psychological Medicine, 36*(2), 159–165.

Faraone, S. V., Asherson, P., Banaschewski, T., Biederman, J., Buitelaar, J. K., Ramos-Quiroga, J. A., Rohde, L. A., Sonuga-Barke, E. J. S., Tannock, R., & Franke, B. (2015). Attention-deficit/hyperactivity disorder. Nature Reviews. *Disease Primers, 1*, 15020. https://doi.org/10.1038/nrdp.2015.20

Fei, Y. F., Ernst, S. D., Dendrinos, M. L., & Quint, E. H. (2021). Preparing for puberty in girls with special needs: A cohort study of caregiver concerns and patient outcomes. *Journal of Pediatric and Adolescent Gynecology, 34*(4), 471–476. https://doi.org/10.1016/j.jpag.2021.03.008

Franke, B., Michelini, G., Asherson, P., Banaschewski, T., Bilbow, A., Buitelaar, J. K., et al. (2018). Live fast, die young? A review on the developmental trajectories of ADHD across the lifespan. *European Neuropsychopharmacology, 28*(10), 1059–1088. https://doi.org/10.1016/j.euroneuro.2018.08.001

French, B., Sayal, K., & Daley, D. (2019). Barriers and facilitators to understanding of ADHD in primary care: A mixed-method systematic review. *European Child & Adolescent Psychiatry, 28*(8), 1037–1064. https://doi.org/10.1007/s00787-018-1256-3

Gadoth, N. (2013). Methylphenidate (Ritalin): What makes it so widely prescribed during the last 60 years? *Current Drug Therapy, 8*(3), 171. https://doi.org/10.2174/15748855113086660009

García-Baos, A., D'Amelio, T., Oliveira, I., Collins, P., Echevarria, C., Zapata, L. P., et al. (2019). Novel interactive eye-tracking game for training attention in children with attention-deficit/hyperactivity disorder. *Primary Care Companion CNS Disorders, 21*(4), 19m02428. https://doi.org/10.4088/PCC.19m02428

Gardner, D. M., & Gerdes, A. C. (2015). A review of peer relationships and friendships in youth with ADHD. *Journal of Attention Disorders, 19*(10), 844–855. https://doi.org/10.1177/1087054713501552

Gates, J. A., Kang, E., & Lerner, M. D. (2017). Efficacy of group social skills interventions for youth with autism spectrum disorder: A systematic review and meta-analysis. *Clinical Psychology Review, 52*, 164–181. https://doi.org/10.1016/j.cpr.2017.01.006

Gerdes, A. C., Haack, L. M., & Schneider, B. W. (2012). Parental functioning in families of children with ADHD: Evidence for behavioral parent training and importance of clinically meaningful change. *Journal of Attention Disorders, 16*(2), 147–156. https://doi.org/10.1177/1087054710381482

Ghirardi, L., Brikell, I., Kuja-Halkola, R., Freitag, C. M., Franke, B., Asherson, P., et al. (2018). The familial co-aggregation of ASD and ADHD: A register-based cohort study. *Molecular Psychiatry, 23*(2), 257–262. https://doi.org/10.1038/mp.2017.17

Ghirardi, L., Pettersson, E., Taylor, M. J., Freitag, C. M., Franke, B., Asherson, P., et al. (2019). Genetic and environmental contribution to the overlap between ADHD and ASD trait dimensions in young adults: A twin study. *Psychological Medicine, 49*(10), 1713–1721. https://doi.org/10.1017/S003329171800243X

Goldin, R. L., Matson, J. L., Tureck, K., Cervantes, P. E., & Jang, J. (2013). A comparison of tantrum behavior profiles in children with ASD, ADHD and comorbid ASD and ADHD. *Research in Developmental Disabilities, 34*(9), 2669–2675. https://doi.org/10.1016/j.ridd.2013.04.022

Gould, J. (2017). Towards understanding the underrecognition of girls and women on the autism spectrum. *Autism, 21*(6), 703–705. https://doi.org/10.1177/1362361317706174

Groenewald, C., Emond, A., & Sayal, K. (2009). Recognition and referral of girls with attention deficit hyperactivity disorder: Case vignette study. *Child: Care, Health and Development, 35*(6), 767–772. https://doi.org/10.1111/j.1365-2214.2009.00984.x

Grzadzinski, R., Di Martino, A., Brady, E., Mairena, M. A., O'Neale, M., Petkova, E., et al. (2011). Examining autistic traits in children with ADHD: Does the autism spectrum extend to ADHD? *Journal of Autism and Developmental Disorders, 41*(9), 1178–1191. https://doi.org/10.1007/s10803-010-1135-3

Grzadzinski, R., Dick, C., Lord, C., & Bishop, S. (2016). Parent-reported and clinician-observed autism spectrum disorder (ASD) symptoms in children with attention deficit/hyperactivity disorder (ADHD): Implications for practice under DSM-5. *Molecular Autism, 7*, 7. https://doi.org/10.1186/s13229-016-0072-1

Harkins, C. M., Handen, B. L., & Mazurek, M. O. (2021). The impact of the comorbidity of ASD and ADHD on social impairment. *Journal of Autism and Developmental Disorders, 52*, 2512. https://doi.org/10.1007/s10803-021-05150-1

Hartman, C. A., Geurts, H. M., Franke, B., Buitelaar, J. K., & Rommelse, N. N. J. (2016). Changing ASD-ADHD symptom co-occurrence across the lifespan with adolescence as crucial time window: Illustrating the need to go beyond childhood. *Neuroscience & Biobehavioral Reviews, 71*, 529–541. https://doi.org/10.1016/j.neubiorev.2016.09.003

Hine, J. F., Allin, J., Allman, A., Black, M., Browning, B., Ramsey, B., et al. (2020). Increasing access to autism spectrum disorder diagnostic consultation in rural and underserved communities: Streamlined evaluation within primary care. *Journal of Developmental & Behavioral Pediatrics, 41*(1), 16–22. https://doi.org/10.1097/dbp.0000000000000727

Hinshaw, S. P. (2018). Attention deficit hyperactivity disorder (ADHD): Controversy, developmental mechanisms, and multiple levels of analysis. *Annual Review of Clinical Psychology, 14*, 291–316. https://doi.org/10.1146/annurev-clinpsy-050817-084917

Jang, J., Matson, J. L., Williams, L. W., Tureck, K., Goldin, R. L., & Cervantes, P. E. (2013). Rates of comorbid symptoms in children with ASD, ADHD, and comorbid ASD and ADHD. *Research in Developmental Disabilities, 34*(8), 2369–2378. https://doi.org/10.1016/j.ridd.2013.04.021

Jansen, A. G., Dieleman, G. C., Jansen, P. R., Verhulst, F. C., Posthuma, D., & Polderman, T. J. C. (2020). Psychiatric polygenic risk scores as predictor for attention deficit/hyperactivity disorder and autism spectrum disorder in a clinical child and adolescent sample. *Behavior Genetics, 50*(4), 203–212. https://doi.org/10.1007/s10519-019-09965-8

Jarbin, H., Andersson, M., Råstam, M., & Ivarsson, T. (2017). Predictive validity of the K-SADS-PL 2009 version in school-aged and adolescent outpatients. *Nordic Journal of Psychiatry, 71*(4), 270–276. https://doi.org/10.1080/08039488.2016.1276622

Jokiranta-Olkoniemi, E., Cheslack-Postava, K., Sucksdorff, D., Suominen, A., Gyllenberg, D., Chudal, R., et al. (2016). Risk of psychiatric and neurodevelopmental disorders among siblings of probands with autism spectrum disorders. *JAMA Psychiatry, 73*(6), 622–629. https://doi.org/10.1001/jamapsychiatry.2016.0495

Jokiranta-Olkoniemi, E., Cheslack-Postava, K., Joelsson, P., Suominen, A., Brown, A. S., & Sourander, A. (2019). Attention-deficit/hyperactivity disorder and risk for psychiatric and neurodevelopmental disorders in siblings. *Psychological Medicine, 49*(1), 84–91. https://doi.org/10.1017/S0033291718000521

Joshi, G., Faraone, S. V., Wozniak, J., Petty, C., Fried, R., Galdo, M., et al. (2014). Examining the clinical correlates of autism spectrum disorder in youth by ascertainment source. *Journal of Autism and Developmental Disorders, 44*(9), 2117–2126. https://doi.org/10.1007/s10803-014-2063-4

Joshi, G., Faraone, S. V., Wozniak, J., Tarko, L., Fried, R., Galdo, M., Furtak, S. L., & Biederman, J. (2017). Symptom profile of ADHD in youth with high-functioning autism spectrum disorder: A comparative study in psychiatrically referred populations. *Journal of Attention Disorders, 21*(10), 846–855. https://doi.org/10.1177/1087054714543368

Juliano, A. C., Alexander, A. O., DeLuca, J., & Genova, H. (2020). Feasibility of a school-based mindfulness program for improving inhibitory skills in children with autism spectrum disorder. *Research in Developmental Disabilities, 101*, 103641. https://doi.org/10.1016/j.ridd.2020.103641

Kaat, A. J., Gadow, K. D., & Lecavalier, L. (2013). Psychiatric symptom impairment in children with autism spectrum disorders. *Journal of Abnormal Child Psychology, 41*(6), 959–969. https://doi.org/10.1007/s10802-013-9739-7

Karalunas, S. L., Hawkey, E., Gustafsson, H., Miller, M., Langhorst, M., Cordova, M., et al. (2018). Overlapping and distinct cognitive impairments in attention-deficit/hyperactivity and autism spectrum disorder without intellectual disability. *Journal of Abnormal Child Psychology, 46*(8), 1705–1716. https://doi.org/10.1007/s10802-017-0394-2

Khan, K., Hall, C. L., Davies, E. B., Hollis, C., & Glazebrook, C. (2019). The effectiveness of web-based interventions delivered to children and young people with neurodevelopmental disorders: Systematic review and meta-analysis. *Journal of Medical Internet Research, 21*(11), e13478. https://doi.org/10.2196/13478

Kilincaslan, A., Mutluer, T. D., Pasabeyoglu, B., Tutkunkardas, M. D., & Mukaddes, N. M. (2016).

Effects of atomoxetine in individuals with attention-deficit/hyperactivity disorder and low-functioning autism spectrum disorder. *Journal of Child and Adolescent Psychopharmacology, 26*(9), 798–806. https://doi.org/10.1089/cap.2015.0179

Kim, S. J., Shonka, S., French, W. P., Strickland, J., Miller, L., & Stein, M. A. (2017). Dose-response effects of long-acting liquid methylphenidate in children with attention deficit/hyperactivity disorder (ADHD) and autism spectrum disorder (ASD): A pilot study. *Journal of Autism and Developmental Disorders, 47*(8), 2307–2313. https://doi.org/10.1007/s10803-017-3125-1

Konst, M. J., Matson, J. L., & Turygin, N. (2013). Comparing the rates of tantrum behavior in children with ASD and ADHD as well as children with comorbid ASD and ADHD diagnoses. *Research in Autism Spectrum Disorders, 7*(11), 1339–1345. https://doi.org/10.1016/j.rasd.2013.07.023

Larsson, H., Chang, Z., D'Onofrio, B. M., & Lichtenstein, P. (2014). The heritability of clinically diagnosed attention deficit hyperactivity disorder across the lifespan. *Psychological Medicine, 44*(10), 2223–2229. https://doi.org/10.1017/S0033291713002493

Leader, G., Dooley, E., Whelan, S., Gilroy, S. P., Chen, J. L., Farren Barton, A., et al. (2021). Attention-deficit/hyperactivity disorder symptoms, gastro-intestinal symptoms, sleep problems, challenging behavior, adaptive behavior, and quality of life in children and adolescents with autism spectrum disorder. *Developmental Neurorehabilitation, 1-12*, 217. https://doi.org/10.1080/17518423.2021.1964005

Lecavalier, L., Smith, T., Johnson, C., Bearss, K., Swiezy, N., Aman, M. G., et al. (2017). Moderators of parent training for disruptive behaviors in young children with autism spectrum disorder. *Journal of Abnormal Child Psychology, 45*(6), 1235–1245. https://doi.org/10.1007/s10802-016-0233-x

Lecavalier, L., McCracken, C. E., Aman, M. G., McDougle, C. J., McCracken, J. T., Tierney, E., et al. (2019). An exploration of concomitant psychiatric disorders in children with autism spectrum disorder. *Comprehensive Psychiatry, 88*, 57–64. https://doi.org/10.1016/j.comppsych.2018.10.012

Lev, A., Braw, Y., Elbaum, T., Wagner, M., & Rassovsky, Y. (2020). Eye tracking during a continuous performance test: Utility for assessing ADHD patients. *Journal of Attention Disorders, 26*, 245. https://doi.org/10.1177/1087054720972786

Locke, J., Shih, W., Kretzmann, M., & Kasari, C. (2016). Examining playground engagement between elementary school children with and without autism spectrum disorder. *Autism, 20*(6), 653–662. https://doi.org/10.1177/1362361315599468

Loomes, R., Hull, L., & Mandy, W. P. L. (2017). What is the male-to-female ratio in autism spectrum disorder? A systematic review and meta-analysis. *Journal of the American Academy of Child & Adolescent Psychiatry, 56*(6), 466–474. https://doi.org/10.1016/j.jaac.2017.03.013

Lord, C. (2012). In M. Rutter (Ed.), *Autism diagnostic observation schedule-second edition (ADOS-2)*. Psychological Corporation.

Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism diagnostic interview-revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 24*(5), 659–685. https://doi.org/10.1007/BF02172145

Loren, R. E., Vaughn, A. J., Langberg, J. M., Cyran, J. E., Proano-Raps, T., Smolyansky, B. H., et al. (2015). Effects of an 8-session behavioral parent training group for parents of children with ADHD on child impairment and parenting confidence. *Journal of Attention Disorders, 19*(2), 158–166. https://doi.org/10.1177/1087054713484175

Lukito, S., Jones, C. R. G., Pickles, A., Baird, G., Happe, F., Charman, T., & Simonoff, E. (2017). Specificity of executive function and theory of mind performance in relation to attention-deficit/hyperactivity symptoms in autism spectrum disorders. *Molecular Autism, 8*, 60. https://doi.org/10.1186/s13229-017-0177-1

Luman, M., van Noesel, S. J., Papanikolau, A., Van Oostenbruggen-Scheffer, J., Veugelers, D., Sergeant, J. A., & Oosterlaan, J. (2009). Inhibition, reinforcement sensitivity and temporal information processing in ADHD and ADHD+ODD: Evidence of a separate entity? *Journal of Abnormal Child Psychology, 37*(8), 1123–1135. https://doi.org/10.1007/s10802-009-9334-0

Luman, M., Janssen, T. W. P., Bink, M., van Mourik, R., Maras, A., & Oosterlaan, J. (2021). Probabilistic learning in children with attention-deficit/hyperactivity disorder. *Journal of Attention Disorders, 25*(10), 1407–1416. https://doi.org/10.1177/1087054720905094

Mademtzi, M., Singh, P., Shic, F., & Koenig, K. (2018). Challenges of females with autism: A parental perspective. *Journal of Autism and Developmental Disorders, 48*(4), 1301–1310. https://doi.org/10.1007/s10803-017-3341-8

Magallon-Neri, E., Vila, D., Santiago, K., Garcia, P., & Canino, G. (2018). The prevalence of psychiatric disorders and mental health services utilization by parents and relatives living with individuals with autism spectrum disorders in Puerto Rico. *Journal of Nervous and Mental Disease, 206*(4), 226–230. https://doi.org/10.1097/NMD.0000000000000760

Mahajan, R., Bernal, M. P., Panzer, R., Whitaker, A., Roberts, W., Handen, B., et al. (2012). Clinical practice pathways for evaluation and medication choice for attention-deficit/hyperactivity disorder symptoms in autism spectrum disorders. *Pediatrics, 130*(Suppl 2), S125–S138. https://doi.org/10.1542/peds.2012-0900J

Mahendiran, T. (2019). Sex differences in social adaptive function in autism spectrum disorder and attention-deficit hyperactivity disorder. *Frontiers in Psychiatry, 10*, 607. https://doi.org/10.3389/fpsyt.2019.00607

Mazurek, M. O., Harkins, C., Menezes, M., Chan, J., Parker, R. A., Kuhlthau, K., & Sohl, K. (2020).

Primary care providers' perceived barriers and needs for support in caring for children with autism. *The Journal of Pediatrics, 221*, 240–245.e241. https://doi.org/10.1016/j.jpeds.2020.01.014

Mikami, A. Y., Smit, S., & Khalis, A. (2017). Social skills training and ADHD-what works? *Current Psychiatry Reports, 19*(12), 93. https://doi.org/10.1007/s11920-017-0850-2

Mohammadi, M. R., Zarafshan, H., Khaleghi, A., Ahmadi, N., Hooshyari, Z., Mostafavi, S. A., & Salmanian, M. (2021). Prevalence of ADHD and its comorbidities in a population-based sample. *Journal of Attention Disorders, 25*(8), 1058–1067. https://doi.org/10.1177/1087054719886372

Molitor, S. J., & Langberg, J. M. (2017). Using task performance to inform treatment planning for youth with ADHD: A systematic review. *Clinical Psychology Review, 58*, 157–173. https://doi.org/10.1016/j.cpr.2017.10.007

Morris, R., Greenblatt, A., & Saini, M. (2019). Healthcare providers' experiences with autism: A scoping review. *Journal of Autism and Developmental Disorders, 49*(6), 2374–2388. https://doi.org/10.1007/s10803-019-03912-6

Mowlem, F., Agnew-Blais, J., Taylor, E., & Asherson, P. (2019). Do different factors influence whether girls versus boys meet ADHD diagnostic criteria? Sex differences among children with high ADHD symptoms. *Psychiatry Research, 272*, 765–773. https://doi.org/10.1016/j.psychres.2018.12.128

Patros, C. H., Alderson, R. M., Kasper, L. J., Tarle, S. J., Lea, S. E., & Hudec, K. L. (2016). Choice-impulsivity in children and adolescents with attention-deficit/hyperactivity disorder (ADHD): A meta-analytic review. *Clinical Psychology Review, 43*, 162–174. https://doi.org/10.1016/j.cpr.2015.11.001

Paulus, F. W., Ohmann, S., Mohler, E., Plener, P., & Popow, C. (2021). Emotional dysregulation in children and adolescents with psychiatric disorders. A Narrative Review. *Front Psychiatry, 12*, 628252. https://doi.org/10.3389/fpsyt.2021.628252

Pedreno, C., Pousa, E., Navarro, J. B., Pamias, M., & Obiols, J. E. (2017). Exploring the components of advanced theory of mind in autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*(8), 2401–2409. https://doi.org/10.1007/s10803-017-3156-7

Pelham, W. E., Jr., Fabiano, G. A., & Massetti, G. M. (2005). Evidence-based assessment of attention deficit hyperactivity disorder in children and adolescents. *Journal of Clinical Child & Adolescent Psychology, 34*(3), 449–476. https://doi.org/10.1207/s15374424jccp3403_5

Pettersson, E., Lichtenstein, P., Larsson, H., Song, J., Attention Deficit/Hyperactivity Disorder Working Group of the iPSYCH-Broad-PGC Consortium, Autism Spectrum Disorder Working Group of the iPSYCH-Broad-PGC Consortium, Bipolar Disorder Working Group of the PGC, Eating Disorder Working Group of the PGC, Major Depressive Disorder Working Group of the PGC, Obsessive Compulsive Disorders and Tourette Syndrome Working Group of the PGC, Schizophrenia CLOZUK, Substance Use Disorder Working Group of the PGC, et al. (2019). Genetic influences on eight psychiatric disorders based on family data of 4 408 646 full and half-siblings, and genetic data of 333 748 cases and controls. *Psychological Medicine, 49*(7), 1166–1173. https://doi.org/10.1017/S0033291718002039

Petts, R. A., & Gaynor, S. T. (2021). Behavioral health in primary care: Brief screening and intervention strategies for pediatric clinicians. *Pediatric Clinics of North America, 68*(3), 583–606. https://doi.org/10.1016/j.pcl.2021.02.010

Peyre, H., Schoeler, T., Liu, C., Williams, C. M., Hoertel, N., Havdahl, A., & Pingault, J. B. (2021). Combining multivariate genomic approaches to elucidate the comorbidity between autism spectrum disorder and attention deficit hyperactivity disorder. *Journal of Child Psychology and Psychiatry, 62*, 1285. https://doi.org/10.1111/jcpp.13479

Pfiffner, L. J., & Haack, L. M. (2014). Behavior management for school-aged children with ADHD. *Child and Adolescent Psychiatric Clinics of North America, 23*(4), 731–746. https://doi.org/10.1016/j.chc.2014.05.014

Pfiffner, L. J., Rooney, M., Haack, L., Villodas, M., Delucchi, K., & McBurnett, K. (2016). A randomized controlled trial of a school-implemented school-home intervention for attention-deficit/hyperactivity disorder symptoms and impairment. *Journal of the American Academy of Child and Adolescent Psychiatry, 55*(9), 762–770. https://doi.org/10.1016/j.jaac.2016.05.023

Pfiffner, L. J., Rooney, M. E., Jiang, Y., Haack, L. M., Beaulieu, A., & McBurnett, K. (2018). Sustained effects of collaborative school-home intervention for attention-deficit/hyperactivity disorder symptoms and impairment. *Journal of the American Academy of Child and Adolescent Psychiatry, 57*(4), 245–251. https://doi.org/10.1016/j.jaac.2018.01.016

Pliszka, S. (2007). Practice parameter for the assessment and treatment of children and adolescents with attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*(7), 894–921.

Polderman, T. J., Benyamin, B., de Leeuw, C. A., Sullivan, P. F., van Bochoven, A., Visscher, P. M., & Posthuma, D. (2015). Meta-analysis of the heritability of human traits based on fifty years of twin studies. *Nature Genetics, 47*(7), 702–709. https://doi.org/10.1038/ng.3285

Politte, L. C., Scahill, L., Figueroa, J., McCracken, J. T., King, B., & McDougle, C. J. (2018). A randomized, placebo-controlled trial of extended-release guanfacine in children with autism spectrum disorder and ADHD symptoms: An analysis of secondary outcome measures. *Neuropsychopharmacology, 43*(8), 1772–1778. https://doi.org/10.1038/s41386-018-0039-3

Postorino, V., Sharp, W. G., McCracken, C. E., Bearss, K., Burrell, T. L., Evans, A. N., & Scahill, L. (2017). A systematic review and meta-analysis of parent training for disruptive behavior in children with autism spectrum disorder. *Clinical Child and Family Psychology Review, 20*(4), 391–402. https://doi.org/10.1007/s10567-017-0237-2

Pugsley, K., Scherer, S. W., Bellgrove, M. A., & Hawi, Z. (2021). Environmental exposures associated with elevated risk for autism spectrum disorder may augment the burden of deleterious de novo mutations among probands. *Molecular Psychiatry, 27*, 710. https://doi.org/10.1038/s41380-021-01142-w

Rao, P. A., & Landa, R. J. (2014). Association between severity of behavioral phenotype and comorbid attention deficit hyperactivity disorder symptoms in children with autism spectrum disorders. *Autism, 18*(3), 272–280. https://doi.org/10.1177/1362361312470494

Reichow, B., Volkmar, F. R., & Bloch, M. H. (2013). Systematic review and meta-analysis of pharmacological treatment of the symptoms of attention-deficit/hyperactivity disorder in children with pervasive developmental disorders. *Journal of Autism and Developmental Disorders, 43*(10), 2435–2441. https://doi.org/10.1007/s10803-013-1793-z

Ros, R., & Graziano, P. A. (2018). Social functioning in children with or at risk for attention deficit/hyperactivity disorder: A meta-analytic review. *Journal of Clinical Child & Adolescent Psychology, 47*(2), 213–235. https://doi.org/10.1080/15374416.2016.1266644

Rynkiewicz, A., Janas-Kozik, M., & Słopień, A. (2019). Girls and women with autism. *Psychiatria Polska, 53*(4), 737–752. https://doi.org/10.12740/PP/OnlineFirst/95098

Salazar, F., Baird, G., Chandler, S., Tseng, E., O'Sullivan, T., Howlin, P., et al. (2015). Co-occurring psychiatric disorders in preschool and elementary school-aged children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 45*(8), 2283–2294. https://doi.org/10.1007/s10803-015-2361-5

Sali, A. W., Anderson, B. A., Yantis, S., Mostofsky, S. H., & Rosch, K. S. (2018). Reduced value-driven attentional capture among children with ADHD compared to typically developing controls. *Journal of Abnormal Child Psychology, 46*(6), 1187–1200. https://doi.org/10.1007/s10802-017-0345-y

Sasson, N. J., Faso, D. J., Nugent, J., Lovell, S., Kennedy, D. P., & Grossman, R. B. (2017). Neurotypical peers are less willing to interact with those with autism based on thin slice judgments. *Scientific Reports, 7*, 40700. https://doi.org/10.1038/srep40700

Scandurra, V., Emberti Gialloreti, L., Barbanera, F., Scordo, M. R., Pierini, A., & Canitano, R. (2019). Neurodevelopmental disorders and adaptive functions: A study of children with autism spectrum disorders (ASD) and/or attention deficit and hyperactivity disorder (ADHD). *Frontiers in Psychiatry, 10*, 673. https://doi.org/10.3389/fpsyt.2019.00673

Scassellati, C., Bonvicini, C., Faraone, S. V., & Gennarelli, M. (2012). Biomarkers and attention-deficit/hyperactivity disorder: A systematic review and meta-analyses. *Journal of the American Academy of Child and Adolescent Psychiatry, 51*(10), 1003–1019 e1020. https://doi.org/10.1016/j.jaac.2012.08.015

Sehlin, H., Hedman Ahlström, B., Andersson, G., & Wentz, E. (2018). Experiences of an internet-based support and coaching model for adolescents and young adults with ADHD and autism spectrum disorder – a qualitative study. *BMC Psychiatry, 18*(1), 15. https://doi.org/10.1186/s12888-018-1599-9

Septier, M., Peyre, H., Amsellem, F., Beggiato, A., Maruani, A., Poumeyreau, M., et al. (2019). Increased risk of ADHD in families with ASD. *European Child & Adolescent Psychiatry, 28*(2), 281–288. https://doi.org/10.1007/s00787-018-1206-0

Shahidullah, J. D., Carlson, J. S., Haggerty, D., & Lancaster, B. M. (2018). Integrated care models for ADHD in children and adolescents: A systematic review. *Families, Systems & Health, 36*(2), 233–247. https://doi.org/10.1037/fsh0000356

Smith, Z. R., & Langberg, J. M. (2018). Review of the evidence for motivation deficits in youth with ADHD and their association with functional outcomes. *Clinical Child and Family Psychology Review, 21*(4), 500–526. https://doi.org/10.1007/s10567-018-0268-3

Soendergaard, H. M., Thomsen, P. H., Pedersen, E., Pedersen, P., Poulsen, A. E., Winther, L., et al. (2016). Associations of age, gender, and subtypes with ADHD symptoms and related comorbidity in a Danish sample of clinically referred adults. *Journal of Attention Disorders, 20*(11), 925–933. https://doi.org/10.1177/1087054713517544

Sonuga-Barke, E., Bitsakou, P., & Thompson, M. (2010). Beyond the dual pathway model: Evidence for the dissociation of timing, inhibitory, and delay-related impairments in attention-deficit/hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(4), 345–355. https://doi.org/10.1016/j.jaac.2009.12.018

Stadnick, N. A., Martinez, K., Aarons, G. A., Lee, D. A., Van Cleave, J., & Brookman-Frazee, L. (2020). Pediatric primary care perspectives on integrated mental health care for autism. *Academic Pediatrics, 20*(8), 1140–1147. https://doi.org/10.1016/j.acap.2020.03.006

Sturman, N., Deckx, L., & van Driel, M. L. (2017). Methylphenidate for children and adolescents with autism spectrum disorder. *Cochrane Database of Systematic Reviews, 11*, CD011144. https://doi.org/10.1002/14651858.CD011144.pub2

Tsang, V., & Chu, P. C. K. (2018). Comparing eye-tracking data of children with high-functioning ASD, comorbid ADHD, and of a control watching social videos. *Journal of Visualized Experiments, 142*. https://doi.org/10.3791/58694

van den Hoofdakker, B. J., van der Veen-Mulders, L., Sytema, S., Emmelkamp, P. M. G., Minderaa, R. B., & Nauta, M. H. (2007). Effectiveness of behavioral parent training for children with ADHD in routine clinical practice: A randomized controlled study. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*(10), 1263–1271. https://doi.org/10.1097/chi.0b013e3181354bc2

van der Oord, S., & Tripp, G. (2020). How to improve behavioral parent and teacher training for children with ADHD: Integrating empirical research on learning and motivation into treatment. *Clinical Child and Family Psychology Review, 23*(4), 577–604. https://doi.org/10.1007/s10567-020-00327-z

Visser, S. N., Danielson, M. L., Bitsko, R. H., Holbrook, J. R., Kogan, M. D., Ghandour, R. M., et al. (2014). Trends in the parent-report of health care provider-diagnosed and medicated attention-deficit/hyperactivity disorder: United States, 2003-2011. *Journal of the American Academy of Child and Adolescent Psychiatry, 53*(1), 34–46.e32. https://doi.org/10.1016/j.jaac.2013.09.001

Weber, L., Kamp-Becker, I., Christiansen, H., & Mingebach, T. (2019). Treatment of child externalizing behavior problems: A comprehensive review and meta-meta-analysis on effects of parent-based interventions on parental characteristics. *European Child & Adolescent Psychiatry, 28*(8), 1025–1036. https://doi.org/10.1007/s00787-018-1175-3

Whitlock, A., Fulton, K., Lai, M. C., Pellicano, E., & Mandy, W. (2020). Recognition of girls on the autism spectrum by primary school educators: An experimental study. *Autism Research, 13*(8), 1358–1372. https://doi.org/10.1002/aur.2316

Yamamuro, K., Tsujii, N., Ota, T., Kishimoto, T., & Iida, J. (2017). Pharmacotherapy for the treatment of aggression in pediatric and adolescent patients with autism spectrum disorder comorbid with attention-deficit hyperactivity disorder: A questionnaire survey of 571 psychiatrists. *Psychiatry and Clinical Neurosciences, 71*(8), 554–561. https://doi.org/10.1111/pcn.12523

Yamawaki, K., Ishitsuka, K., Suyama, S., Suzumura, S., Yamashita, H., & Kanba, S. (2020). Clinical characteristics of boys with comorbid autism spectrum disorder and attention deficit/hyperactivity disorder. *Pediatrics International, 62*(2), 151–157. https://doi.org/10.1111/ped.14105

Yerys, B. E., Bertollo, J. R., Pandey, J., Guy, L., & Schultz, R. T. (2019). Attention-deficit/hyperactivity disorder symptoms are associated with lower adaptive behavior skills in children with autism. *Journal of the American Academy of Child and Adolescent Psychiatry, 58*(5), 525–533.e523. https://doi.org/10.1016/j.jaac.2018.08.017

Young, H., Oreve, M.-J., & Speranza, M. (2018). Clinical characteristics and problems diagnosing autism spectrum disorder in girls. *Archives de Pédiatrie, 25*(6), 399–403. https://doi.org/10.1016/j.arcped.2018.06.008

Young, S., Adamo, N., Ásgeirsdóttir, B. B., Branney, P., Beckett, M., Colley, W., et al. (2020a). Females with ADHD: An expert consensus statement taking a lifespan approach providing guidance for the identification and treatment of attention-deficit/ hyperactivity disorder in girls and women. *BMC Psychiatry, 20*(1), 404. https://doi.org/10.1186/s12888-020-02707-9

Young, S., Hollingdale, J., Absoud, M., Bolton, P., Branney, P., Colley, W., et al. (2020b). Guidance for identification and treatment of individuals with attention deficit/hyperactivity disorder and autism spectrum disorder based upon expert consensus. *BMC Medicine, 18*(1), 146. https://doi.org/10.1186/s12916-020-01585-y

Zablotsky, B., Bramlett, M. D., & Blumberg, S. J. (2017). The co-occurrence of autism spectrum disorder in children with ADHD. *Journal of Attention Disorders, 24*, 94. https://doi.org/10.1177/1087054717713638

Generalization and Maintenance

21

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Contents

The exponential increase in the quantity of research literature investigating the effectiveness of interventions for people with autism spectrum disorders (ASD) has continued over the past 10 years. A considerable amount of this research falls into the behavioral domain (applied behavior analysis, ABA); however, even in the field's flagship journal (*Journal of Applied Behavior Analysis* [JABA]), many reported interventions do not include information or data on generalization and maintenance of behavior change. This is a dismal observation given the importance behavior analysts place on the social significance of their work. Of what social significance is an

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intervention that does not support behavior change across people, places, and time?

This chapter seeks to outline the importance of generalization, how to overcome any barriers experienced by learners with autism to generalize, to reiterate the importance of teaching and training practices that have generalization and maintenance "built in," and to review strategies for promoting generalization and maintenance. We did not conduct a comprehensive review of generalization and maintenance in published ASD intervention research. We did look closely at the literature published in JABA over the past 5 years and sampled the wider literature to provide examples of the various strategies that are used to promote generalization and maintenance. The additional research and clinical work that we have done in the past 10 years have led to us updating and revising recommendations that we previously provided.

What Is Generalization and Maintenance?

In the very first issue of JABA, generalization of behavior change was included as one of the field's defining characteristics (Baer et al., 1968). Behavior change was said to have generalized if it lasts over time, it occurs in many environments, and/or if it spreads to related behaviors. These three tenets of generalized behavior change (i.e., across time, settings, and behaviors) have been reiterated over time (e.g., Stokes & Baer, 1977) and can be extended to include strategies that increase the rate of learning of new discriminations, e.g., stimulus equivalence and recombinative generalization.

As a behavioral practitioner, the most important thing we do is to leave the conditions for our learner better than they were when we arrived. To do this, our learners need to achieve generalized behavior change in socially significant behaviors. This is not achieved by an afterthought following the teaching of a new behavior. Our learners need to know that handwashing is an important skill that needs to be completed regardless of whether the taps are levers or twist faucets, and the soap is bar or liquid. Our learners also benefit from generalized skills such as being able to recruit attention from others, rather than just from the practitioner who taught a particular mand to decrease attention maintained hitting behavior.

Stimulus Control and Discrimination

A child who runs around the playground enthusiastically and then sits quietly in class illustrates how our behavior changes according to the context or circumstances. When our behavior changes in response to the environment, we say that it is under stimulus control. Stimulus control is very important to learning as when it is not established, or incorrectly established, behaviors occur in environments where they are less preferred or potentially unsafe. For example, our young learner with autism who runs around enthusiastically in both the playground and the classroom has not acquired stimulus control with respect to running. That is, the stimulus control that occurs when we present a positive reinforcer or withdraw a negative reinforcer contingent on the response of running outside has not been established. We note that the term stimulus control has been used in many ways; however, in this chapter we are talking about it as discriminative control.

In our example of "you can only run outside," we want fairly strong stimulus control. We require our learner to attend to the cues in the environment, the lack of walls and doors, the presence of playground equipment, and the verbal instruction from the teacher to "go play." This means you can run. Inside, however, our learner is required to observe the relevant inside stimuli and the teacher instruction "no running." As you can see, there are a variety of stimuli for a learner to attend to in this situation. We may wish to simplify this by bringing the behavior of running under the control of a salient stimulus, the instruction "run." Establishing this kind of stimulus control requires differential reinforcement. We can achieve this reinforcing run when we say "run," and not reinforcing running at any other times, i.e., extinction. A more complex example of this would be in the case of conditional stimulus control. Many discriminations we make in daily life are conditional discriminations. That is reinforcement of a response in the presence of a stimulus depends on the presence of other stimuli. If we think specifically about our early learners with autism, a common early curriculum target is teaching auditory visual matching, i.e., receptive language. The procedure typically consists of the presentation of an auditory sample, such as a dictated object label, with visual comparisons, such as an array of objects. For example, the practitioner says "shoe" in the presence of a shoe, a hat, and a sock. A correct response would be the learner touching, picking up or in some way orienting towards the shoe. The learner has made a discrimination and the behavior of touching the shoe, the discriminated operant, occurs more frequently under the antecedent condition of the practitioner saying "shoe," than it does at any other time. If the child was to pick up something else, the consequence would not be reinforcement, but error correction or extinction to decrease the likelihood of that behavior occurring again.

Generalization

The countereffect of stimulus discrimination is generalization. Many things in day-to-day life require loose stimulus control or generalization. In our example of teaching receptive language, our young learner with autism is able to select the shoe from an array of objects upon hearing the word "shoe." However, the behavior is limited to the practitioner saying "shoe" in the presence of that particular blue shoe with red laces. The issue here is, our learner likely has more than one pair of shoes, in fact, the shoe that was taught may not even belong to the learner. Shoes come in different sizes, shapes, colors, and styles. Our learner will have many shoes over their lifetime. To be useful, our learner needs to know the concept or idea of shoe. Our learner benefits from loose stimulus control that is generalization.

The occurrence of generalization is not a passive phenomenon. This is particularly true for our learners with autism who may attend to stimuli in the environment that others consider to be irrelevant (e.g., Rincover & Koegel, 1975). We know that plans for generalization need to be incorporated into interventions rather than assuming it will occur, continuing to do nothing, and lamenting when it does not spontaneously occur is not an effective strategy. When interventions do not generalize and maintain either the intervention or learner is blamed. An alternative approach would be to plan for generalizing from the beginning of an intervention. After all, there is no such thing as a poor learner, there are only poor teachers.

Prior to furthering our discussion on what it means to "plan for generalization" we must first understand what generalization means. There are three basic forms of generalized behavior change: stimulus generalization, response generalization, and response maintenance.

Stimulus Generalization

Stimulus generalization is when a behavior is evoked by an antecedent stimulus that has not previously controlled the behavior (Cooper et al., 2020). Following on from our example of teaching the word "shoe," if our learner were to hear the word "shoe" and pick up a shoe other than the training stimulus, e.g., his sibling's shoes, or pointed to a picture of a shoe in a book, this would be stimulus generalization. Further examples would be touching or picking up other shoes (shoes in a range of colors and sizes) upon hearing the word "shoe." As with animals, we (humans) have evolved such that when two stimuli have a large degree of physical similarity, the more likely it is that stimulus generalization will occur between them. In teaching other skills, like hand washing stimulus generalization is also very useful. We want our learner to wash their hands in a new situation that is different to the teaching setting (different bathrooms) and stimuli (different taps, soap dispensers, towels).

Response Generalization

Response generalization is seen when the learner emits a new, untrained behavior that is functionally equivalent to the behavior that was trained (Cooper et al., 2020). For example, where our child who learnt receptive identification of shoes by picking up the blue shoe with red laces, now responds to by saying "shoe" when holding a shoe, we have response generalization. In the example of handwashing, if our hand washer were to dry their hands by wiping them on their pants, this would be response generalization. Drying one's hands on one's pants is not necessarily desirable. However, drying hands on one's pants does have the same function as using a towel, as it results in getting one's hands dry. The use of hand sanitizer is also an example of response generalization as one's hands are clean without the complex multistep handwashing chain.

Response Maintenance

Response maintenance occurs when the learner continues to perform the behavior trained after the intervention responsible for the behavior has ceased (Cooper et al., 2020). A newly learned behavior should maintain in the person's life for as long as they need it or for as long as it is useful to them. This may depend on whether the natural contingencies in the environment continue to reinforce it. We hope that our learner will wash their hands whenever they are dirty, or at the very least before and after meals, after using the toilet and, given the world move to increased hygiene standards, use hand sanitizer when it is placed in their visual range, e.g., at entrance to retail establishments. Our learner should be able to "know" what a shoe is, in that they can get their shoes when asked. We also hope our learner can develop and generalize other skills around shoes, such as putting them on when you go outside.

Generalization and ASD

The theories of autism and its treatment have undergone a substantial shift in the 40 years since it was first included as a label in the diagnostic and statistical manual (Vivanti & Messinger, 2021). With these changes in conceptualization of ASD, some of the reasons (e.g., primary deficit accounts) that have been posited for why children have difficulty with generalization are less relevant. We have moved away from treatments that "do to" people to treatments that promote the choices and preferences of people.

In a complex world with multiple competing stimuli, it is relatively easy for stimulus control to not lie with the relevant stimuli. Using a go/no-go procedure in a standard blocking paradigm Olaff et al. (2021) found adding a second discriminative stimulus (sound) to the already acquired visual discriminative stimulus, stimulus control by the sound was blocked for all three autistic participants. Perhaps it is not that children with autism lack a skill, it is just that they learn differently and as practitioners it is our responsibility to develop a method of teaching that is effective.

Stimulus Overselectivity

Difficulties with generalization and maintenance may arise due to stimulus overselectivity. Stimulus overselectivity, or restricted stimulus control, can be defined as strong or exclusive control by one feature of a stimulus, or a small subset of features, at the expense of control by other relevant features of the stimulus (Lovaas et al., 1971; see also Cipani, 2012; Ploog, 2010). In other words, not all aspects of the stimulus (or stimuli) that are relevant to the discrimination control behavior. Instead, only a few of the relevant features control behavior, and in some cases, irrelevant features may also exert control. For example, a child who only recognized shoes when they had red laces (the trained shoe had red laces) would be said to be overselective in making the discrimination "shoe" or "not-shoe." In this case, behavior is controlled by an irrelevant feature, instead of by the features that collectively define the concept of "shoe." Similarly, a child learning to read the word "STOP" may learn based on only the first two letters of the word, resulting in incorrect identification of other words beginning with the letters "ST" (e.g., "STAR," "STEP"; see, e.g., Birnie-Selwyn & Guerin, 1997).

In Lovaas et al.'s (1971) landmark study demonstrating overselectivity, children were trained to press a bar when a compound stimulus comprised of visual (a red light), auditory (63-dB white noise), and tactile (a blood-pressure cuff) components was presented for 5 seconds at regular intervals. After learning the discrimination, each stimulus component was presented individually. Children with autism tended to respond to a single component, children with intellectual or developmental disabilities responded to two components, and typically developing children responded to all three components. Thus, the children with autism demonstrated stimulus overselectivity, and to a much greater extent than children without autism. A large body of evidence since Lovaas et al.'s study now suggests that children with autism are more likely to display stimulus overselectivity than typically developing children (see Lovaas et al., 1979; Ploog, 2010 for comprehensive reviews). Furthermore, overselectivity may be greater in children with Level 3 (requiring very substantial support) autism than Level 1 (requiring support) autism, a relationship that appears to be mediated by verbal IQ (Kelly et al., 2015).

Although discrimination learning may appear successful despite overselectivity occurring, such learning may not generalize or maintain if the stimulus features controlling behavior (e.g., the red laces in our shoe discrimination) are absent. That is, overselectivity may not be apparent until generalization or maintenance probes are conducted. Rincover and Koegel (1975) demonstrated this clearly in a study in which ten children with autism learned to follow simple commands from a teacher (e.g., "touch your chin"). After learning the behavior, transfer tests were conducted in which the commands were given by different teachers in different classrooms. Four of the 10 children failed to generalize the behavior to these novel environments; this was because their behavior during original training had been under the control of irrelevant stimuli (e.g., hand gestures, furniture in the room) rather than the vocal command. Likewise, Koegel and Rincover (1976) found that when extra-stimulus "guiding" prompts were used to teach new discriminations, children with autism did not acquire the new discrimination because behavior was under the control of the prompting stimuli. As a result, learning was not maintained when the prompting stimuli were faded. In contrast, typically developing children responded appropriately to the stimuli relevant to the new discrimination, and this was maintained when the prompting stimuli were faded (see also Schreibman, 1975). More recently, Falcomata et al. (2007) found that when treating pica behavior (a form of self-injury involving ingesting inedible objects) in a child with autism, behavior was controlled by the therapist's presence rather than by the discriminative stimuli signaling the treatment contingencies (see also, e.g., Schreibman & Lovaas, 1973). These examples illustrate the detrimental effects of stimulus overselectivity on generalization and maintenance.

Characteristics of the stimuli and procedure used in discrimination training may influence the extent to which overselectivity is observed (see Ploog, 2010 for a review). Leader et al. (2009) found that children with autism displayed much greater overselectivity in a simultaneous discrimination task when the components of the compound stimuli were more unequal in salience (one component was more intense in color) than when the components were equally salient. Other research suggests that using more complex stimuli (e.g., stimuli with a large number of features or components) engenders greater overselectivity (Burke & Cerniglia, 1990; Dube & McIlvane, 1997). Using too few exemplars during discrimination learning (e.g., one shoe as in our example) may also increase the likelihood of overselectivity, as the learner may acquire the discrimination based on only a few select features of the specific training stimuli (Halbur et al., 2021). Similarly, overselectivity is more likely with shorter discrimination training (Koegel & Schreibman, 1977). Poor observing of, or lack of attention to, all relevant stimuli may also contribute to overselectivity (e.g., Dube et al., 2010; Farber et al., 2017; Walpole et al., 2007).

Taken together, these findings suggest that overselectivity may be reduced by (1) using stimuli with equally salient features; (2) using stimuli that are not too complex (or perhaps starting with simpler stimuli before gradually shaping a more complex discrimination); (3) using many exemplars during training; (4) arranging longer training or overtraining a discrimination; and (5) introducing observing contingencies that require learners to attend to all relevant stimuli (see Halbur et al., 2021; Ploog, 2010 for further discussions).

On a final note, research since Lovaas et al. (1971) has shown that overselectivity is not unique to autism, and that its prevalence in children with autism may be related to mental/developmental age and verbal functioning, rather than to autism diagnosis per se (Gersten, 1983; Kelly et al., 2015; Schover & Newsom, 1976; see Ploog, 2010 for further discussion). Furthermore, Rieth et al. (2015) recently suggested that the current prevalence of overselectivity in children with autism may be lower—though still greater than the prevalence of overselectivity in typically developing children—than in the 1970s, partially due to better-designed conditional-discrimination procedures that aim to reduce overselectivity (e.g., through the use of multiple exemplars). Thus, behavior analysts should consider factors besides autism diagnosis—such as verbal ability—when designing interventions, and where overselectivity may be a concern, interventions should arrange discrimination procedures to minimize overselectivity. Doing so will help to reduce the potential negative impacts of overselectivity on generalization and maintenance.

Current Practices

A review of the last 5 years of JABA was conducted to obtain a snapshot of the field's programming and assessment for generalization and maintenance where the participants had diagnoses of autism. We found that less than quarter (24.8%) of the research conducted assessed maintenance. Where maintenance was assessed, it was generally only for weeks or a couple of months at best, with the exception of Wheatley et al. (2020) who assessed maintenance of wearing an anti-strip suit at the 18-month point. The reason for the lack of maintenance, may be that many of the 2020 and 2021 articles were related to pandemic response, and therefore, the opportunity for long-term maintenance assessment was not practical. There appeared to be no specific programming for maintenance in most of the research reviewed. Where specific strategies could be identified from the description of the procedure, the most common involved varying the contingencies to more closely resemble the natural contingencies (e.g., schedule thinning, naturally accruing antecedents and reinforcers) and training significant others in the person's environment.

In reviewing the assessment and programming for generalization, less than half (41.6%) of the research conducted assessed generalization to other people, setting, stimulus or response. The only paper to assess all four was Grob et al. (2019), who looked at teaching job-related social skills to adults with ASD. Of the studies that did assess generalization, many had no comparative baseline point and no clear programming strategy other than train and hope (Stokes & Baer, 1977). Where programming did occur, only a handful of studies specifically mentioned the strategy used, with multiple exemplars being the most common. The utility of multiple exemplars was further supported by LaFrance and Tarbox (2020) who published a discussion paper in JABA on the use of multiple exemplars for facilitating novel verbal behavior. A review of researchers' methods identified that other common strategies including training loosely, having a stimulus that mediated generalization, or training behavior change agents in the natural setting. Finally, the influence of behavioral momentum and the need to understand the factors influence resurgence was clear over the last 5 years (e.g., Falligant et al. 2021). This understanding of how we can program better during intervention to avoid resurgence is still rather translational in its application, however, will be important for facilitating generalization and maintenance of clinical gains.

It is worth commenting further on the explosion of research and practice that has occurred via telehealth in the past 2 years. Telehealth has had a presence in the literature for around 20 years and has ranged from consultation, diagnosis, training, and intervention for children with autism. Nohelty et al. (2021) found direct telehealth therapy using discrete trial teaching and natural environment teaching formats was successful at teaching a range of social language and adaptive skills. These skills were maintained and generalized across family members. This success could be due to many reasons, e.g., using family members as teachers, training skills at home, and training with stimuli in the home. Generalization and maintenance when using telehealth is not specifically reviewed in this chapter, it would, however, make for an interesting review as further research emerges.

Strategies to Promote Generalization

At the beginning of any intervention, the behavioral practitioner should identify all the behaviors that need to be changed and all the settings and situations in which the behavior should occur. Returning to our example of shoe identification, the desired outcome is for our learner to recognize all shoes in all forms (e.g., pictures, photos, live, textual) in all settings (e.g., home, grandparents' house, school, outside) and with all people (stimulus generalization). We may also wish our leaner to be able to expressively identify shoes, and sort shoes (response generalization). That plan should include how the identification of shoe will maintain in the natural environment and that it will occur in all forms and relevant environments. And of course, is it socially valid or relevant for our learner to "know" what a shoe is? Given that shoes are a common feature in day-to-day life, that require identification, putting on and doing up, and are often associated with other behaviors such as running outside, we can anticipate social validity in this example. We can also anticipate that there will be sufficient opportunities for the concept of shoe to maintain in the environment outside of structured teaching.

In addition to the strategies that Stokes and Baer (1977) propose for promoting generalization, we would like to encourage practitioners to also consider setting up learning situations that produce more learning. That is, teach four discriminations and get four or even 16 more without specific training. Strategies such as recombinative generalization and stimulus equivalence are special cases of stimulus generalization that are often not used by behavior practitioners in day-to-day curriculum development for children with autism. Generalization across subjects (imitation) can also be seen as stimulus generalization and is a skill we should actively program for, as generalized imitation can be a tool for future learning. It is these extra examples of stimulus generalization strategies that we will review now, prior to a more detailed review of Stokes and Baer's recommendations.

Generalization as Learning to Learn

More rapid learning of new discriminations based on past learning of similar discriminations in the past is not a new concept. In 1949, Harlow demonstrated the formation of learning sets and discussed the advantage of these as learning to learn.

Recombinative Generalization

Recombinative generalization occurs when correct responding to novel (i.e., untrained) stimulus combinations occur, and these stimulus components have previously been reinforced in other stimulus contexts (Goldstein, 1983). Pauwels et al. (2015) used a matrix training procedure to successfully teach tacting of kitchen items and prepositions to three females diagnosed with ASD. Two of the three participants showed recombinative generalization of untrained combinations. In matrix training, a subset of combinations is taught followed by probes of untrained combinations. In this study, participants were initially taught object and physical relations, such as strainer under, whisk right, and in later testing untrained combinations, e.g., strainer right, whisk right emerged.

Stimulus Equivalence

Sidman (1971) identified stimulus equivalence as when correct responding to untrained stimulus-stimulus relations occurs. In the first study demonstrating stimulus equivalence, a 17-year-old with an intellectual disability could match pictures to their spoken names and pictures. After being taught to match written names to spoken names, the young man could, without additional training, match written names to pictures, match pictures to written names, and say the written words. The result of learning one stimulus-stimulus relation was the emergence of three other relations without direct training. Sidman and Tailby (1982) described this in the logical formulation: if A = B and B = C, then A = C. The advantages of this when designing curriculum for children with ASD are clear: A decrease in the time taken to teach stimulus-stimulus relations. In theory, if A is the spoken word "shoe,"B is the picture of a shoe, and C the written word shoe, we could train the stimulus relations spoken word "shoe" to picture and picture to written word SHOE and spoken word "shoe" to written word SHOE would emerge without further training.

The Promoting the Emergence of Advanced Knowledge (PEAK: Dixon, 2015) system is an assessment and curriculum guide composed of four unique modules of which one is equivalence. Using this module McKeel and Matas (2017) implemented a transitivity program utilizing the gustatory sensory modality. A gustatory stimulus was trained to a visual picture, and then the visual picture to a spoken word. Results showed that all three participants, with diagnoses of ASD and ID, not only mastered the trained relations but were also able to derive new relations without direct training.

Generalization Across Subjects

Further to leaning how to learn by acquiring new discriminations more quickly, imitation is another efficient way of acquiring skills. Having taught one child to wash their hands if another child in the same house, who was not directly taught, started washing their hands too, this would be an example of generalization across children, i.e., imitation. Imitation is an important aspect of skill development as it allows us to learn new things by watching those around us. Most children learn everything from motor skills to language and play skills by watching their parents, siblings, caregivers, and peers do things. Children with autism may need to be taught this skill specifically.

The standard curriculum approach is to teach imitation skills through discrete trial teaching, advancing from gross, to fine, oral motor and then vocal verbal imitation. Imitations are often taught in sets of three with maintenance scheduled for previously learned generalization and probes for untrained generalization with the hope that elusive generalized imitation or imitating anything, anywhere, anytime by anyone will emerge after sufficient pairings. Strategies such as video modelling (Durand & Koegel, 2010) and mirror training (Du & Greer, 2014) have been found to support the acquisition of generalized imitation.

Generalization, the Technology

Stokes and Baer (1977) categorized strategies for promoting behavior change under nine general headings. Eight of which require active planning, some before mastery is achieved and others after. Train and Hope while common and one of Stokes and Baer's original list does not require behavioral partitioners to do anything so will not be discussed further in this chapter.

Sequential Modification

Sequential modification addresses generalization only after behavior change has occurred (Stokes & Baer, 1977). It is common for a practitioner to teach one good example of something and expect the learner to generalize from that. In our example, we have taught our learner one example of shoe (the blue shoe with the red lace). Once mastered, we probe to see if generalization has occurred across stimuli, people, and settings. Probes may be conducted with different shoes in flashcard and other forms (e.g., pictures in books, actual shoes), with different instructors and in different locations.

Conine et al. (2019) taught four children with ASD to respond to their name, as well as not respond to other names. After initial mastery of the task, probes showed that for most participants increases in responding to name did not reach mastery in generalized contexts. Conine et al. sequentially generalized to another experimenter, a varied location, and the natural environment with the introduction of tangible reinforcers as used in the initial intervention.

Introduce to Natural Maintaining Contingencies

We have already discussed that for behavior to continue to occur outside the teaching environment, it must continue to make contact with its maintaining contingencies naturally. The naturally existing contingencies are those that are present before the practitioner comes into the environment. When selecting a target behavior, the practitioner should look to see if the behavior change will have the opportunity meet those contingencies. If a behavior is not followed by a reinforcer, at least sometimes, it is not functional for the learner. However, if we look at only teaching skills that are reinforced in the natural environment, we will potentially deprive our learners of a whole range of adaptive behavior for which the natural environment does not provide sufficient reinforcement. The goal here may be to teach the learner to recruit reinforcement from other sources in the environment, or we can work with carers and teachers to increase the amount of reinforcement available. We can ask people in the generalization setting to reinforce the behavior. When the natural reinforcement is low, we can “wake up” any potential natural reinforcement in the environment (Baer, 1999). This is especially important if the schedule cannot be thinned to a point that the natural contingencies will take effect (e.g., Tarbox et al., 2002) and we may have to train those in the environment. If the behavior is of importance to those in the natural environment the likelihood of the practitioner being able to recruit others to provide the necessary reinforcement is enhanced.

Train Sufficient Exemplars

Training sufficient exemplars is the most common generalization strategy observed in teaching learners with autism. Early intensive behavior interventions (EIBI) programs routinely teach receptive and expressive language using multiple training stimuli. Training sufficient exemplars can be done using either a serial or concurrent method. When teaching serially we teach the receptive discrimination using one shoe. After this has been mastered and there is no evidence of generalization to other shoes, another shoe exemplar would be taught, then another, and another until the learner can identify shoes of all different forms, e.g., different color, style, and shapes of shoes. When teaching receptive identification concurrently examples of many shoes are the target stimuli from the beginning of teaching. Wunderlich et al. (2014) found that when preschool children with developmental delays were taught to identify letters or letter sounds using serial and concurrent presentation methods, all the children reached mastery criterion in fewer training session when the concurrent method was used. Furthermore, the concurrent method also resulted in greater generalization to untrained examples.

Multiple exemplar training was also used by Dass et al. (2018) to successfully teach children with ASD to tact olfactory stimuli. Using discrete trial teaching, participants were taught three fruity and three citrus smells in initial training. All participants generalized to a fourth smell without further training.

Train Loosely

Behavior analysts like to control and standardize interventions. This, however, is counterproductive to generalization. Strict adherence to procedures may restrict generalization. To train loosely is to randomly vary noncritical aspects of the training of the environment. Teaching loosely reduces the likelihood that a single noncritical element of the teaching environment will acquire exclusive control over the behavior. Stokes and Baer (1977) recommended that practitioners use loose teaching by varying random stimuli in the training setting such as temperature, tone of voice, trainers, and noise level in addition to further examples. When teaching on-task ice skating to a 6-year-old boy with autism, Bord et al. (2016) identified features of the ice arena that varied across days, including music genre, presence or absence of people, and direction of skating during sessions. Teaching loosely is also useful for avoiding any “surprises” that the child may encounter in the generalization setting

(Horner et al., 1988). Loose teaching is often observed in language teaching programs that use natural environment and incidental teaching methods (e.g., McGee et al., 1999).

Use Indiscriminable Contingencies

As noted, earlier practitioners should strive to select behaviors that have naturally occurring contingencies despite these contingencies sometimes being weak. An indiscriminable contingency is one where the learner cannot discriminate whether or not the next response will be reinforced. The idea of using an indiscriminable contingency is for the learner to continue responding often and long enough in the generalization (natural) setting such that the behavior will come into contact with the naturally occurring contingencies. Behavioral practitioners use two techniques program indiscriminable contingencies: intermittent reinforcement and delayed rewards. Intermittent reinforcement is where the learner does not receive immediate reinforcement for every response but only for some responses. During the initial stage of developing behaviors, or when strengthening seldom used behaviors, every correct response is reinforced. Depending upon the learner's performance, the schedule of reinforcement can be thinned. The thinner the schedule, the more indistinguishable it is from the natural environment. Research shows that behavior that is reinforced on an intermittent schedule is more resistant to extinction, and as such should be more likely to generalize (Stokes & Baer, 1977). If using delayed rewards, the time between the behavior and the reinforcer is gradually increased. This strategy may be more useful when the learner is less supported as it helps if it can be communicated to the learner what the reinforcer is for, when it is delivered.

Program Common Stimuli

Generalization can also be promoted by making the training setting similar to the generalization setting. Programming common stimuli requires the training environment to contain stimuli comparable to those in the generalization setting (Stokes & Baer, 1977). For example, in teaching the receptive identification of shoes, our goal may be for the child to point to pictures of shoes in a book during circle time in their preschool class. If we were promoting generalization through the programming of common stimuli, we would create a similar environment for training purposes. This may involve using the teacher as the instructor, simulating circle time by having peers present during training, turn-taking responses, and using the same materials as those in the classroom. If the common stimuli are well chosen, functional, and salient during training the likelihood of generalization will be enhanced (Stokes & Baer, 1977).

Wichnick-Gillis et al. (2019) used the training stimuli that were used in the school to promote generalization of social initiations in the home. Three boys with autism were taught to initiate social interactions across various activities in the school setting using a script fading package. Generalization probes were taken at home throughout the baseline and script fading phases with the same stimuli that were used for training at school. The intervention package was never introduced in the home; however, social initiations increased in this setting (common stimuli, untrained setting, and untrained conversation partner).

Mediate Generalization

Generalization may be promoted by arranging for something or person to act as a medium that ensures the target behavior is transferred to the generalized setting. There are two common tactics when using this strategy. The practitioner can contrive a mediating stimulus or teach the learner to mediate their own generalization though self-management. Examples of contrived mediating stimuli used with children with autism include many strategies familiar to those working with children with autism. For example, the use of cue cards (e.g., O'Neill & Sweetland-Baker, 2001), photographic activity schedules (e.g., MacDuff et al., 1993), and the Picture Exchange Communication System (PECS; Bondy & Frost, 1994).

People are also highly successful as mediating stimuli as they are highly transportable and move from setting to setting and often provide reinforcement for many behaviors (Cooper et al., 2020). The possible downside of using people is that they are not always readily available in the initial training settings. However, peers in social settings are Goldstein and Wickstrom (1986) used a peer-mediated intervention to increase interactions among three preschoolers who had characteristics suggestive of ASD. Two additional preschoolers (peers) were taught strategies such as gaining eye contact and prompting requests to facilitate interactions with the target peers. The peers were then also present as mediating stimuli in non-training sessions where interactions remained at levels higher than baseline.

Activity schedules with embedded scripts and peers were used by Akers et al. (2018) to mediate the generalization of playing hide and seek. Three preschool children with ASD were taught to play hide and seek using activity schedules with embedded scripts. Once the children, with ASD, began engaging in independent hide and seek behaviors the activity schedules were faded to be less intrusive. Participants continued to play hide and seek with the faded version of the activity schedule in a different setting 2 weeks after the intervention concluded. Interestingly the typical peers also continued to use the faded activity schedules post intervention.

Self-management involves the learner applying behavior change strategies to themselves to produce a change in the target behavior. Self-management can have many components, including: the learner observing and recording their own behavior (self-monitoring or self-recording), comparing their performance to a pre-determined criterion (self-evaluation), and administering reinforcement (self-reinforcement). Self-management has recently been used with children with autism to manage food portions for an adolescent (Chagolla & Penrod, 2021), to decrease motor stereotypies in social interactions (Tereshko et al., 2021) and increase physical activity, using a photographic activity schedule, in three preschool children with ASD (Becerra et al., 2021).

Train to Generalize

Training to generalize suggests "to generalize" is an operant response rather than an outcome of behavior change and as such can be trained (Cooper et al., 2020). Possibly the simplest way to achieved generalized change is to ask the leaner to generalize. Stokes and Baer (1977) suggested that practitioners could obtain cost-effective generalization by using systematic instructions to inform the learner on what is required in other situations. While many children with ASD have good listening skills and are able to follow rules we could not find any examples of asking the learner to generalize in the literature with children with ASD.

The most common tactic of training to generalize is reinforcing response variability. The idea is that that if practitioners can increase variability in responding, they would obtain response generalization. Response variability can solve problems, produce valued novel behavior, and expose the learner to sources of reinforcement not previously accessible. The use of lag schedules, to achieve variability in responding for children with autism, has increased over the past 5 years.

Lag schedules involve reinforcing a response if it is different from the preceding responses. For example, a Lag 1 response schedule would require that the current response be different from the previous response, but not necessarily different from the response that had occurred two responses ago. In comparison, a Lag 2 response schedule would require that the current response be different from the two previous responses, but not different from the third previous response. Radley et al. (2019) found five 10–14-year-olds with ASD, who attended a twice weekly social skills group had low levels of skill accuracy and variability pre intervention. Using behavior skills training with between one and three exemplars had little or no effect on variability despite an increase in accuracy. The introduction of lag 2 and then lag 4 schedules led to an increase in variability in the target skills, maintaining a conversation, participation, expressing wants and needs, and responding to questions. Post-intervention rating scales completed by the learners' parents indicated an increase in social skills and a decrease in repetitive behavior.

Lag schedules were also used by Silbaugh et al. (2020) to look at their effect on mand variability during functional communication training to decrease challenging behavior for four pre-school children with ASD. Lag 1 schedules with or without prompts increased variability in responding; however, clinically significant reductions in challenging behavior were not observed.

While training an individual to generalize may be an effective tool to ensure generalization, ideally, we would want the learner to generalize not only their behavior but also their ability to generalize. Stokes and Baer (1977) labeled individuals who had been taught this skill as "generalized generalizers." A concept that many practitioners who work with supported learners with ASD seek to achieve. We were not able to find any research on "generalized generalizers."

Planning for Generalized Outcomes

In this section, we make recommendations to practitioners regarding *planning* for generalization. The planning is undertaken as part of the development of any plan for behavior change at the outset, not as an afterthought. An intervention plan for a referred behavior should include consideration of desired generalization across behaviors, stimuli, settings, and people, with the last being maintenance of behavior change in the future beyond the intervention. In our experience of planning for generalization in practice, we previously relied on the "generalization map" designed by Drabman et al. (1979). The map presented a conceptual model for categorizing domains of generalization addressed in the ABA research literature. We found this helpful as a conceptual model, and for research applications, but less so as a tool for practitioners. Thus, we designed a "generalization planner" for applied use (see Arnold-Saritepe et al., 2009). After using this planner in multiple iterations over the last decade, we have further revised this for clinical use (see Fig. 21.1).

The middle box in Fig. 21.1 considers the initial teaching or intervention context, specifically, the relevant topography, stimuli, people, or setting. The outer boxes allow the practitioner to brainstorm the relevant domains of generalization, in turn informing the decision making with respect to planning the appropriate teaching or intervention context (i.e., where to start). The domains of generalization also help to inform the appropriate strategies for generalization which should be planned from the outset. In Fig. 21.2, a pre-filled example is provided for teaching hand-washing, a topical skill considering the impacts of COVID-19 worldwide. In terms of specific domains, these can be considered in any order. The behavior analyst can determine the topography, or the class of behaviors to be changed across the variety of response forms that are functionally equivalent (e.g., varied responses that obtain soap from a dispenser). If the intervention aims to teach new desirable forms of behavior that are related, these will be listed here (e.g., using hand sanitizer in the absence of water). Conversely, if the intervention also aims to reduce other problem behaviors, they can be listed here.

In planning for generalization across stimuli, the range of materials required to perform the desired generalized behavior are listed (e.g., tap, soap, hand towel). The naturally occurring antecedent stimuli for appropriate performance of the desired behavioral responses need to be considered here. In the example of hand washing, this requires consideration of the most common contexts for the individual, and the stimuli present in these locations (e.g., a roller towel or an air dryer?).

Settings can then be listed, considering the range of environments where the individual will need to maintain the skill (e.g., bathrooms at other family homes, school). In general, for a child with ASD, obvious settings include home, school, and the community. However, in planning specifically for generalization, the exact settings and locations need to be specified. For example, in which bathrooms at the school does hand washing most often occur? Another example

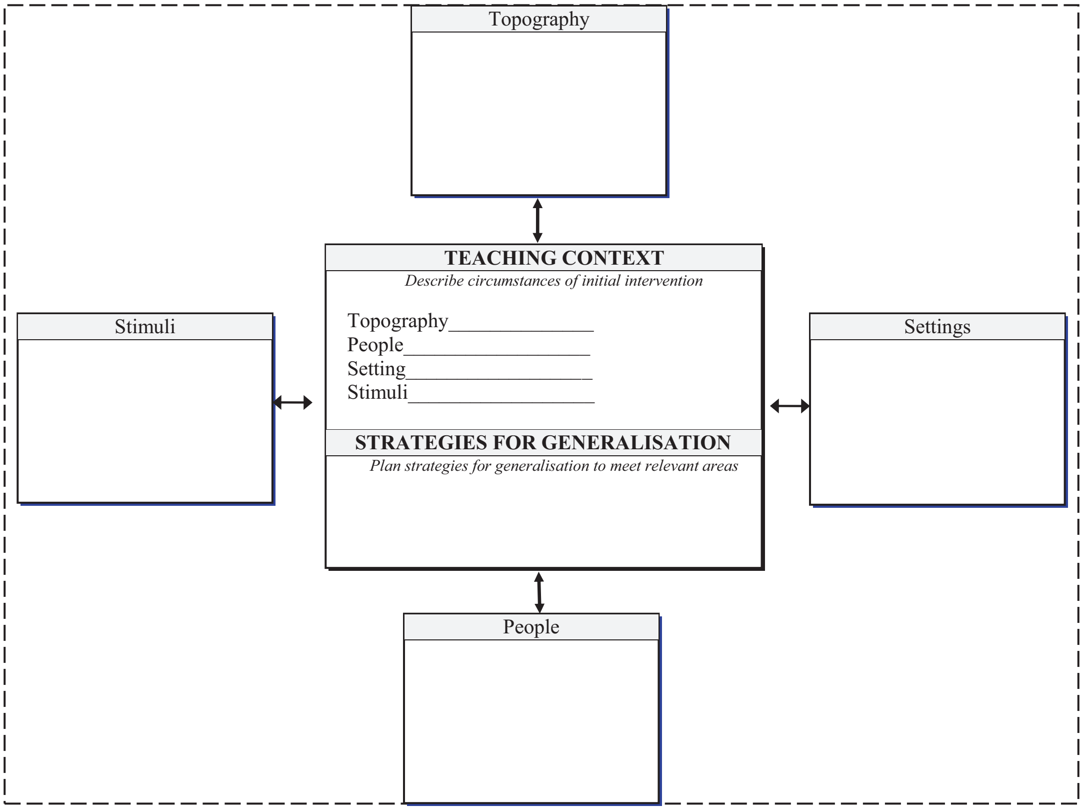

Fig. 21.1 Generalization planner (blank) showing teaching context and strategies for generalization (middle), stimuli, topography, settings, and people (outer boxes)

might be: What is the name of the health center where the child sees the doctor?

Finally, under the heading of "people," we recommend that the program designer list the names of people in whose presence the changed behavior is to occur, e.g., which family members, teaching staff, and/or health care providers. It is also worthwhile to consider whether the particular skill or behavior is one that should ultimately occur at full independence. For instance, hand washing should ultimately occur at independence to allow dignity in bathrooms, and thus prompt fading should be planned concurrently.

A comprehensive assessment process should inform the planning of generalization domains depicted in Figs. 21.1 and 21.2. From post-referral (but pre-intervention), the practitioner should conduct interviews with the child with ASD where possible, all those who care about and for the child, and via direct observations in the child's natural environments. Interviews may be guided by the "generalization planner," and observations of the child's behaviors are likely to add information about the forms of response to be targeted (e.g., what form of verbal behavior the child uses (verbal, vocal, signs, gestures, PEC, etc.)). Observations in the child's natural current and likely future environments, including of peers, will enhance information about instructional and naturally occurring stimuli surrounding the desired behaviors.

At this point in planning, the analyst has exhaustive lists to place in the boxes as in Fig. 21.1. Before intervention commences, however, prioritization among response class members, stimulus materials, settings, and people is a complex task that needs to be undertaken. Prioritization is best negotiated, with guidance from the behavior analyst, with those informants

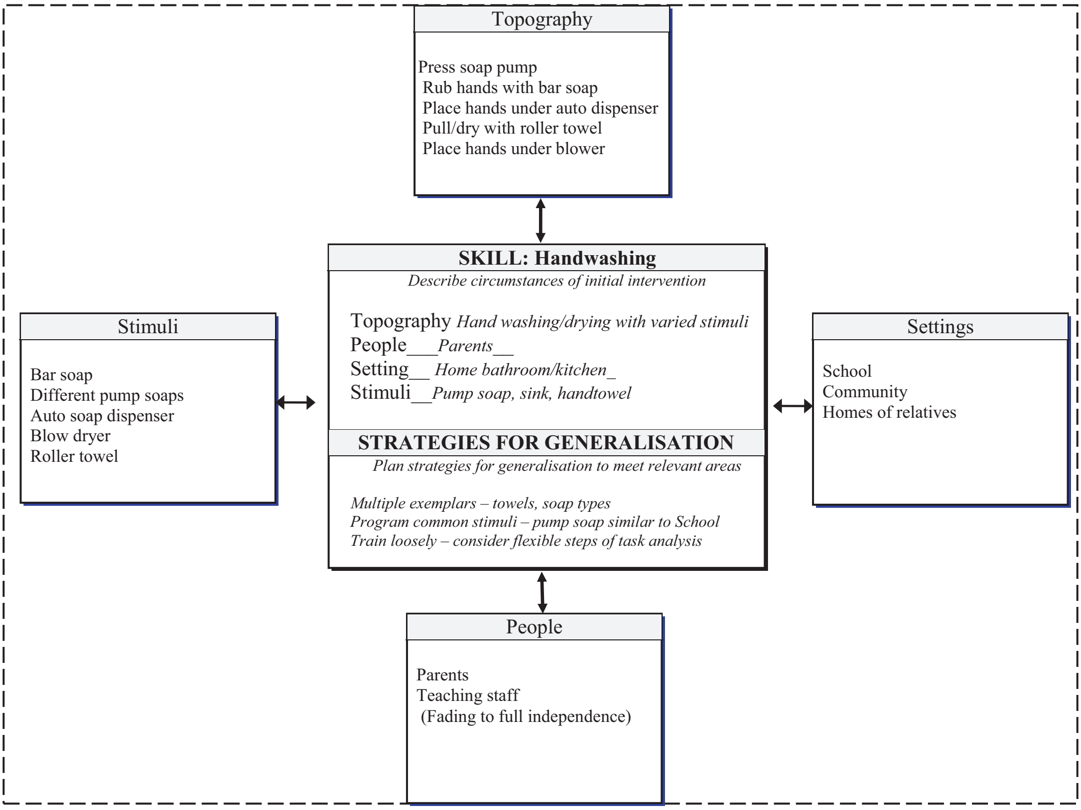

Fig. 21.2 Generalization planner example for teaching handwashing

who contributed to the lists during the interviews. The inclusion of the child, if possible, and parents in decision-making procedures of this type may be required by law in some jurisdictions. With regard to generalization planning for a particular intervention, a starting point has to be decided, e.g., what is the best setting in which to determine if the proposed intervention is effective and perhaps fine-tune it before generalizing to a new setting? In addition, at what point does the intervention end? Though we have planned for and measured behavior change in new settings what would we expect to happen when an unidentified setting occurs a year after the intervention? Intervention should end when the reinforcing contingencies that naturally occur in the environment take over, thus the behavior should transfer to the new setting a year later without any need for reintroduction of the intervention. To provide further guidance in the use of the planner, a case example from a published clinical intervention follows which focuses on intervention for severe challenging behavior (Taylor et al., 2018).

Case Example

Client Information

Adam is a 12-year-old boy who attends mainstream school. He has previously been diagnosed with autism spectrum disorder, attention-deficit/hyperactivity disorder, and dyspraxia. Adam has been referred for behavioral intervention following prolonged challenging behavior at school, involving multiple episodes of aggression, property destruction, and elopement. As a result of these behaviors, Adam is currently isolated from his classroom for a reduced school day (four hours), where he completes few academic tasks (instead plays iPad games). When staff attempt to place academic demands, challenging behavior may increase to the point where Adam's mother is phoned to come and collect him.

Referral Question

Adam was referred to a behavior analyst due to prolonged challenging behavior in the school setting. The goal identified by Adam's mother and school staff was to slowly integrate him back to the classroom with his peers. Adam's mother reported that challenging behaviors were not of concern in the home environment, but she acknowledged that demands were reduced, and preferred activities are more available.

Behavior Assessment

Through the process of interviews with caregivers, school staff, and observation of Adam at home and school settings, the behavior analyst was able to identify the following target behaviors; whining, crying, property destruction, and aggression. A functional assessment revealed that all the target behaviors occurred to provide Adam with escape from demands, as well as access to tangibles (specifically the iPad).

Intervention

Target behaviors occurred at such intensity that there was considerable risk to staff and peers nearby. Thus, the initial context of intervention was planned to be within the school setting, but prior to the school year starting. The intervention involved functional communication training, combined with preference-based teaching, whereby Adam helped determine the hierarchy of task demands. Alternative behaviors to be prioritized included communication (i.e., a functional communication response, FCR), tolerance, and following varied instructions. Staff and family were consulted about the feasibility of this intervention, and as all the disruptive behaviors had the same function, it was agreed to work on them all at once.

Planning for Generalization

As a part of intervention development, a generalization planner (Fig. 21.3) was completed. Topographically different behaviors of the same function were grouped for intervention. The maintaining stimuli were identified and the locations of the targeted behavior were listed in the order of intervention. It was decided that the generalization strategy of sequential modification would be most effective when considering settings, given the risks inherent in progressing to the general classroom setting (i.e., to peers). Given safety risks, it was also determined that the most appropriate initial intervention context was one without peers or general teaching staff present (i.e., 1 week prior to the school year starting). This was followed by continued one:one teaching when peers returned to school, with a trained teacher aide. Finally, Adam integrated into the general classroom, with his classroom teacher trained to implement the intervention. In terms of other generalization strategies, common stimuli were programmed during the initial context, by conducting intervention at school, with relevant materials (e.g., workbooks, science equipment) and locations (e.g., field, hallway, court area). Further, support staff were included in the initial teaching context as soon as possible, to become discriminative stimuli for FCR, tolerance, and compliance. For example, once Adam was independently providing the initial communication response, the support staff continued those trials, while the analyst implemented trials targeting the next behavior (tolerance).

The overall process of functional communication training (specifically, skills-based treatment) fostered generalization through the use of indiscriminable contingencies, whereby response requirements were randomized across trials (i.e., communication alone, or varied task requirements). The week after the initial intervention context, the intervention was then advanced across the entire school day, with full implementation by trained support staff who then continued to mediate generalization when Adam returned to the classroom.

Results

Over the course of the intervention, challenging behaviors reduced to low levels, while targeted alternative behaviors improved. Within approximately 2 months, Adam progressed to spending the full school day within the regular classroom

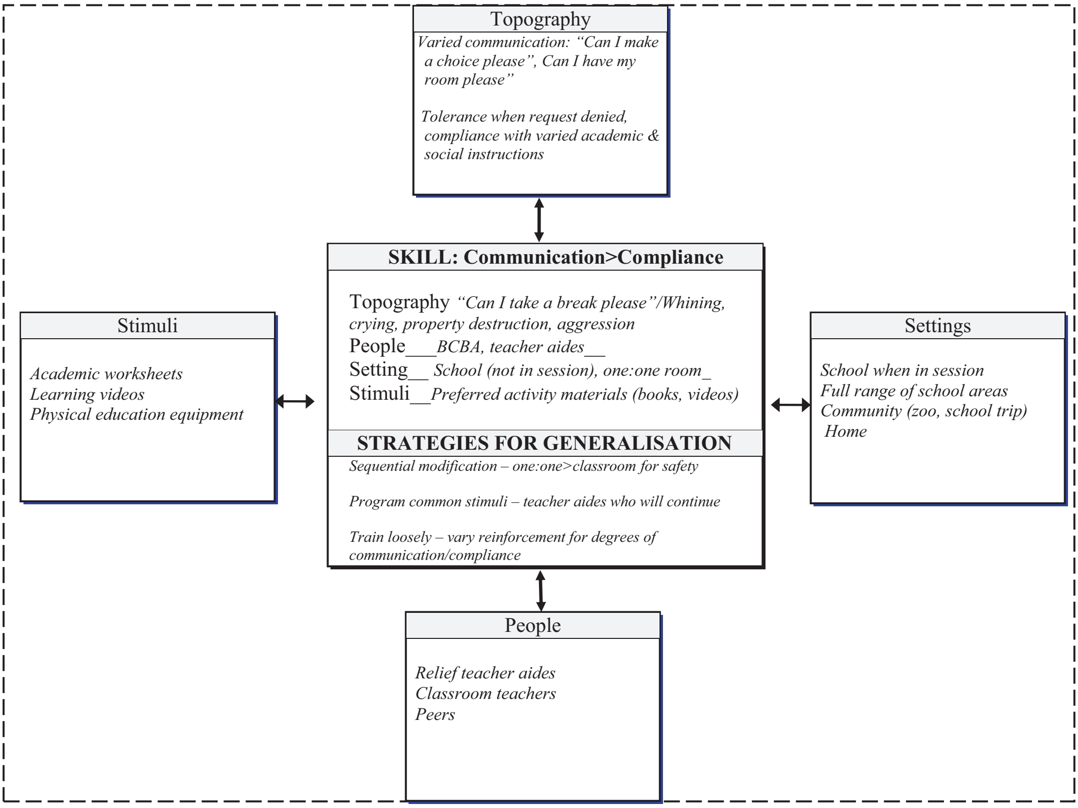

Fig. 21.3 Generalization planner for Adam's communication and compliance

and engaged in the majority of school activities. Adam was completing the majority of academic activities independently, with occasional assistance from his teacher aide. Improvements were also seen in Adam's academic performance, measured via writing, reading, math, and science assessments.

Concluding Summary and Recommendations

If the literature is a reflection on what the behavioral practitioner is doing in practice, we, the practitioners, are doing a dismal job. Less than a quarter of the reviewed articles from the last 5 years of JABA included comment on maintenance and less than half look to program for generalization in any way. If we are not actively engaging in steps to promote all forms of generalization, across people, settings, stimuli, and time, we are not engaging in behavior consistent with applied behavior analysis. We are missing Baer et al's. (1968) generality dimension far too frequently and we would also argue we are missing the applied dimension. If applied refers to the importance it has to society, what use does it have to anyone if our leaner can only wash their hands with their teacher in the school bathroom? Given how long it takes children to learn some skills, taking the effort to ensure appropriate and ongoing generalization is necessary to create cost-effective and socially valid results.

A considerable volume of research exists within the applied behavior analytic literature that provides us with strategies to address generalization and maintenance of behavior. Within Stokes and Baer's (1977) technologies, we have a plethora of strategies we can put in place, e.g., behavior skills training, training peers and staff, video modelling, various prompts and cues, that have been demonstrated to be successful in facilitating generalization. Furthermore, we have strategies that can facilitate stimulus generalization as we teach, e.g., stimulus equivalence, recombinative generalization and teaching imitation.

It is also imperative that the natural maintaining contingencies be determined. Why should our learner continue to wash their hands after the backward chaining procedure, with most to least prompts and a contrived reinforcer, once the practitioner goes away? Handwashing is very important for health reasons and is something we, adults, have become very good at. A child with autism is possibly not at all interested in these reasons. Perhaps placing handwashing in a chain of behaviors around toileting and food preparation and consumption that culminates in access to the mobile phone or preferred food may be sufficient to maintain the behavior. Many of our daily behaviors (e.g., handwashing, showering, tying out shoelaces) do not have positive naturally maintaining contingencies. It is our role as the behavior analyst / practitioner to promote the establishment and maintenance of behaviors before withdrawing from the environment. Sitting and waiting for it to occur is not sufficient, nor is it the fault of our learner if it does not occur. Our goal is to make meaningful and socially significant changes in the lives of children with autism.

References

Akers, J. S., Higbee, T. S., Gerencser, K. R., & Pellegrino, A. J. (2018). An evaluation of group activity schedules to promote social play in children with autism. *Journal of Applied Behavior Analysis, 51*, 553–570. https://doi-org.ezproxy.auckland.ac.nz/10.1002/jaba.474

Arnold-Saritepe, A. M., Phillips, K. J., Mudford, O. C., De Rozario, K. A., & Taylor, S. A. (2009). Generalization and maintenance. In J. L. Matson (Ed.), *Applied behavior analysis for children with autism spectrum disorders* (pp. 207–224). Springer New York. https://doi.org/10.1007/978-1-4419-0088-3_12

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Baer, D. M. (1999). How to plan for generalization. PRO-ED.

Becerra, L. A., Higbee, T. S., Vieira, M. C., Pellegrino, A. J., & Hobson, K. (2021). The effect of photographic activity schedules on moderate-to-vigorous physical activity in children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 54*, 744–759. https://doi.org/10.1002/jaba.796

Birnie-Selwyn, B., & Guerin, B. (1997). Teaching children to spell: Decreasing consonant cluster errors by eliminating selective stimulus control. *Journal of Applied Behavior Analysis, 30*(1), 69–91. https://doi.org/10.1901/jaba.1997.30-69

Bondy, A., & Frost, L. (1994). The picture exchange communication system. *Focus on Autistic Behavior, 9*, 1–19. https://doi.org/10.1177/108835769400900301

Bord, S., Sidener, T. M., Reeve, K. F., & Sidener, D. W. (2016). Teaching on-task rollerblading and ice-skating to a child with autism. *Behavior Analysis in Practice, 10*(2), 178–182. https://doi.org/10.1007/s40617-016-0150-z

Burke, J. C., & Cerniglia, L. (1990). Stimulus complexity and autistic children's responsivity: Assessing and training a pivotal behavior. *Journal of Autism and Developmental Disorders, 20*, 233–253. https://doi.org/10.1007/BF02284721

Chagolla, G. A., & Penrod, B. (2021). Decreasing number of food portions consumed by an adolescent female with autism. *Behavior Analysis in Practice*, No Pagination Specified. https://doi.org/10.1007/s40617-021-00647-8

Cipani, E. (2012). Stimulus overselectivity: Empirical basis and diagnostic methods. *The Behavior Analyst Today, 13*(1), 3–11. https://doi.org/10.1037/h0100712

Conine, D. E., Vollmer, T. R., & Bolívar, H. A. (2019). Response to name in children with autism: Treatment, generalization, and maintenance. *Journal of Applied Behavior Analysis*. https://doi.org/10.1002/jaba.635

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis*. Pearson.

Dass, T. K., Kisamore, A. N., Vladescu, J. C., Reeve, K. F., Reeve, S. A., & Taylor-Santa, C. (2018). Teaching children with autism spectrum disorder to tact olfactory stimuli. *Journal of Applied Behavior Analysis, 51*(3), 538–552. https://doi.org/10.1002/jaba.470

Dixon, M. R. (2015). *P.E.A.K. relational training system: Equivalence*. Shawnee Scientific Press, LLC.

Drabman, R. S., Hammer, D., & Rosenbaum, M. S. (1979). Assessing generalization in behavior modification with children: The generalization map. *Behavioral Assessment, 1*, 203–219.

Du, L., & Greer, R. D. (2014). Validation of adult generalized imitation topographies and the emergence of generalized imitation in young children with autism as a function of mirror training. *The Psychological Record, 64*, 161–177. https://doi.org/10.1007/s40732-014-0050-y

Dube, W. V., & McIlvane, W. J. (1997). Reinforcer frequency and restricted stimulus control. *Journal of the Experimental Analysis of Behavior, 68*(3), 303–316. https://doi.org/10.1901/jeab.1997.68-303

Dube, W. V., Dickson, C. A., Balsamo, L. M., O'Donnell, K. L., Tomanari, G. Y., Farren, K. M., Wheeler, E. E., & McIlvane, W. J. (2010). Observing behavior and atypically restricted stimulus control. *Journal of the Experimental Analysis of Behavior, 94*(3), 297–313. https://doi.org/10.1901/jeab.2010.94-297

Durand, V. M., & Koegel, R. L. (2010). What's inside: Highlights from this issue. *Journal of Positive Behavior Interventions, 12*, 67–68. https://doi.org/10.1177/1098300710365848

Falcomata, T. S., Roane, H. S., & Pabico, R. R. (2007). Unintentional stimulus control during the treatment of pica displayed by a young man with autism. *Research in Autism Spectrum Disorders, 1*(4), 350–359. https://doi.org/10.1016/j.rasd.2006.12.004

Falligant, J. M., Kranak, M. P., McNulty, M. K., Schmidt, J. D., Hausman, N. L., & Rooker, G. W. (2021). Prevalence of renewal of problem behavior: Replication and extension to an inpatient setting. *Journal of Applied Behavior Analysis, 54*(1), 367–373. https://doi.org/10.1002/jaba.740

Farber, R. S., Dickson, C. A., & Dube, W. V. (2017). Reducing overselective stimulus control with differential observing responses. *Journal of Applied Behavior Analysis, 50*(1), 87–105. https://doi.org/10.1002/jaba.363

Gersten, R. (1983). Stimulus overselectivity in autistic, trainable mentally retarded, and non-handicapped children: Comparative research controlling chronological (rather than mental) age. *Journal of Abnormal Child Psychology, 11*, 61–75. https://doi.org/10.1007/BF00912178

Goldstein, H. (1983). Recombinative generalization: Relationships between environmental conditions and the linguistic repertoires of language learners. *Analysis & Intervention in Developmental Disabilities, 3*(4), 279–293. https://doi.org/10.1016/0270-4684(83)90002-2

Goldstein, H., & Wickstrom, S. (1986). Peer intervention effects on communicative interaction among handicapped and nonhandicapped preschoolers. *Journal of Applied Behavior Analysis, 19*(2), 209–214. https://doi.org/10.1901/jaba.1986.19-209

Grob, C. M., Lerman, D. C., Langlinais, C. A., & Villante, N. K. (2019). Assessing and teaching job-related social skills to adults with autism spectrum disorder. *Journal of Applied Behavior Analysis, 52*(1), 150–172. https://doi.org/10.1002/jaba.503

Halbur, M. E., Caldwell, R. K., & Kodak, T. (2021). Stimulus control research and practice: Considerations of stimulus disparity and salience for discrimination training. *Behavior Analysis in Practice, 14*, 272–282. https://doi.org/10.1007/s40617-020-00509-9

Harlow, H. F. (1949). The formation of learning sets. *Psychological Review, 56*(1), 51–65. https://doi.org/10.1037/h0062474

Horner, R. H., Dunlap, G., & Koegel, R. L. (1988). *Generalization and maintenance*. Paul H. Brookes Publishing.

Kelly, M. P., Leader, G., & Reed, P. (2015). Stimulus overselectivity and extinction-induced recovery of performance as a product of intellectual impairment and autism severity. *Journal of Autism and Developmental Disorders, 45*, 3098–3106. https://doi.org/10.1007/s10803-015-2466-x

Koegel, R. L., & Rincover, A. (1976). Some detrimental effects of using extra stimuli to guide learning in normal and autistic children. *Journal of Abnormal Child Psychology, 4*, 59–71. https://doi.org/10.1007/BF00917605

Koegel, R. L., & Schreibman, L. (1977). Teaching autistic children to respond to simultaneous multiple cues. *Journal of Experimental Child Psychology, 24*(2), 299–311. https://doi.org/10.1016/0022-0965(77)90008-X

LaFrance, D. L., & Tarbox, J. (2020). The importance of multiple exemplar instruction in the establishment of novel verbal behavior. *Journal of Applied Behavior Analysis, 53*(1), 10–24. https://doi.org/10.1002/jaba.611

Leader, G., Loughnane, A., McMoreland, C., & Reed, P. (2009). The effect of stimulus salience on overselectivity. *Journal of Autism and Developmental Disorders, 39*, 330–338. https://doi.org/10.1007/s10803-008-0626-y

Lovaas, O. I., Schreibman, L., Koegel, R., & Rehm, R. (1971). Selective responding by autistic children to multiple sensory input. *Journal of Abnormal Psychology, 77*(3), 211–222. https://doi.org/10.1037/h0031015

Lovaas, O. I., Koegel, R. L., & Schreibman, L. (1979). Stimulus overselectivity in autism: A review of research. *Psychological Bulletin, 86*(6), 1236–1254. https://doi.org/10.1037/0033-2909.86.6.1236

MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. *Journal of Applied Behavior Analysis, 26*, 89–97. https://doi.org/10.0901/jaba.1993.26-89

McGee, G. G., Morrier, M. J., & Daly, T. (1999). An incidental teaching approach to early intervention for toddlers with autism. *Journal of the Association for Persons with Severe Handicaps, 24*(3), 133–146. https://doi.org/10.2511/rpsd.24.3.133

McKeel, A., & Matas, J. (2017). Utilizing peak relational training system to teach visual, gustatory, and auditory relations to adults with developmental disabilities. *Behavior Analysis in Practice, 10*(3), 252–260. https://doi.org/10.1007/s40617-017-0194-8

Nohelty, K., Bradford, C. B., Hirschfeld, L., Miyake, C. J., & Novack, M. N. (2021). Effectiveness of telehealth direct therapy for tndividuals with autism spectrum disorder. *Behavior analysis in practice 15*(3), 643–658. https://doi.org/10.1007/s40617-021-00603-6

O'Neill, R. E., & Sweetland-Baker, M. (2001). Brief report: An assessment of stimulus generalization and contingency effects in functional communication training with two students with autism. *Journal of Autism and Developmental Disorders, 31*, 235–240. https://doi.org/10.1023/a:1010711518182

Olaff, H. S., Vandbakk, M., & Holth, P. (2021). Blocking of stimulus control in children with

autism. *Psychological Record, 72*, 305. https://doi.org/10.1007/s40732-020-00454-7
Pauwels, A. A., Ahearn, W. H., & Cohen, S. J. (2015). Recombinative generalization of tacts through matrix training with individuals with autism spectrum disorder. *The Analysis of Verbal Behavior, 31*(2), 200–214. https://doi.org/10.1007/s40616-015-0038-y
Ploog, B. O. (2010). Stimulus overselectivity four decades later: A review of the literature and its implications for current research in autism spectrum disorder. *Journal of Autism and Developmental Disorders, 40*, 1332–1349. https://doi.org/10.1007/s10803-010-0990-2
Radley, K. C., Moore, J. W., Dart, E. H., Ford, W. B., & Helbig, K. A. (2019). The effects of lag schedules of reinforcement on social skill accuracy and variability. *Focus on Autism and Other Developmental Disabilities, 34*, 67–80. https://doi.org/10.1177/1088357618811608
Rieth, S. R., Stahmer, A. C., Suhrheinrich, J., & Schreibman, L. (2015). Examination of the prevalence of stimulus overselectivity in children with ASD. *Journal of Applied Behavior Analysis, 48*(1), 71–84. https://doi.org/10.1002/jaba.165
Rincover, A., & Koegel, R. L. (1975). Setting generality and stimulus control in autistic children. *Journal of Applied Behavior Analysis, 8*(3), 235–246. https://doi.org/10.1901/jaba.1975.8-235
Schover, L. R., & Newsom, C. D. (1976). Overselectivity, developmental level, and overtraining in autistic and normal children. *Journal of Abnormal Child Psychology, 4*, 289–298. https://doi.org/10.1007/BF00917765
Schreibman, L. (1975). Effects of within-stimulus and extra-stimulus prompting on discrimination learning in autistic children. *Journal of Applied Behavior Analysis, 8*(1), 91–112. https://doi.org/10.1901/jaba.1975.8-91
Schreibman, L., & Lovaas, O. I. (1973). Overselective response to social stimuli in autistic children. *Journal of Abnormal Child Psychology, 1*, 152–168. https://doi.org/10.1007/BF00916110
Sidman, M. (1971). Reading and auditory-visual equivalences. *Journal of Speech and Hearing Research, 14*, 5–13. https://doi.org/10.1044/jshr.1401.05
Sidman, M., & Tailby, W. (1982). Conditional discrimination vs. matching to sample: An expansion of the testing paradigm. *Journal of Experimental Analysis of Behavior, 37*, 5–22. https://doi.org/10.1901/jeab.198.37-5
Silbaugh, B. C., Swinnea, S., & Falcomata, T. S. (2020). Replication and extension of the effects of lag schedules on mand variability and challenging behavior during functional communication training. *Analysis of Verbal Behavior, 36*, 49–73. https://doi.org/10.1007/s40616-020-00126-1
Stokes, T. F., & Baer, D. M. (1977). An implicit technology of generalization. *Journal of Applied Behavior Analysis, 10*, 349–367. https://doi.org/10.1901/jaba1977.10-349
Tarbox, J., Wallace, M. D., & Tarbox, R. S. F. (2002). Successful generalized parent training and failed schedule thinning of response blocking for automatically maintained object mouthing. *Behavioral Interventions, 17*, 169–178. https://doi.org/10.1002/bin.116
Taylor, S. A., Phillips, K. J., Gertzog, M. G. (2018). Use of synthesized analysis and informed treatment to promote school reintegration. *Behavioral Interventions. 33*(4), 364–379. https://doi.org/10.1002/bin.1640
Tereshko, L., Ross, R. K., & Frazee, L. (2021). The effects of a procedure to decrease motor stereotypy on social interactions in a child with autism spectrum disorder. *Behavior Analysis in Practice, 14*, 367–377. https://doi.org/10.1007/s40617-020-00516-w
Vivanti, G., & Messinger, D. S. (2021). Theories of autism and autism treatment from the DSM III through the present and beyond: Impact on research and practice. *Journal of Autism and Developmental Disorders, 51*(12), 4309–4320. https://doi.org/10.1007/s10803-021-04887-z
Walpole, C. W., Roscoe, E. M., & Dube, W. V. (2007). Use of a differential observing response to expand restricted stimulus control. *Journal of Applied Behavior Analysis, 40*(4), 707–712. https://doi.org/10.1901/jaba.2007.707-712
Wheatley, T. L., Goulet, M., Mann, K., & Lanovaz, M. J. (2020). Differential negative reinforcement of other behavior to increase compliance with wearing an anti-strip suit. *Journal of Applied Behavior Analysis, 53*(2), 1153–1161. https://doi.org/10.1002/jaba.632
Wichnick-Gillis, A. M., Vener, S. M., & Poulson, C. L. (2019). Script fading for children with autism: Generalization of social initiation skills from school to home. *Journal of Applied Behavior Analysis, 52*, 451–466. https://doi.org/10.1002/jaba.534
Wunderlich, K. L., Vollmer, T. R., Donaldson, J. M., & Phillips, C. L. (2014). Effects of serial and concurrent training on acquisition and generalization. *Journal of Applied Behavior Analysis, 47*(4), 723–737. https://doi.org/10.1002/jaba.154

Parent Training Interventions to Applied Behavior Analysis (ABA)

22

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Contents

Introduction

Parents, daycare providers, teachers, and primary care providers (PCPs), such as doctors and nurse practitioners, can all play a key role in the early identification of autism spectrum disorder (ASD). However, given that parents spend the most time with their children and know their behaviors, moods, and daily skill repertoires best, they are an excellent resource in detecting initial symptoms of concern, which can lead to early assessment, diagnosis, and intervention. Most recently, the Centers for Disease Control and Prevention (CDC) have stated that in the United States, 1 in 54 children will be diagnosed with ASD and 1 in 6 children, between 3 and 17 years of age, are diagnosed with a developmental disability (Centers for Disease Control and Prevention,

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2020a). However, prevalence rates worldwide are likely higher as children with more subtle social communication markers and fewer behavioral issues may go undetected (Marlow et al., 2019). In addition, diagnostic discrepancies with ethnicity and race continue to suggest that stigma and lack of awareness or access to resources still affect the accurate diagnostic identification of some individuals. Therefore, continuing to increase awareness of early markers of ASD, and giving parents the tools and education to assist in the early detection of high-risk infants, remains an important objective.

Parents have the opportunity to play a principal position in early identification, even before birth, if they are informed of the role of genetics and ASD during the early stages of pregnancy. Research has shown that high-risk infants are more likely to have familial backgrounds with developmental, medical, and/or psychiatric conditions (Feldman et al., 2019). Therefore, ensuring that PCPs fully notify parents of the importance of researching and sharing information related to family history conditions could better help all parties to understand the level of risk. Additionally, sharing background information could potentially lead to parents gaining increased knowledge regarding the early identification of symptoms and access to appropriate ASD screeners once the child is born. Early developmental delays that can be noticeable after the child is born, such as limitations with eye contact, joint attention skills, social smiling, or lack of responding to their name are all key social communication markers of ASD (Barbaro & Freeman, 2021). These markers are all observable behaviors that parents, if informed and made aware of, can monitor and voice concerns to their PCPs to increase the likelihood of screening at a very early age. However, if parents are not specifically asked about certain, more subtle symptoms (Hyman et al., 2020) then they may not disclose these behavioral traits as concerns (Marlow et al., 2019), which could then lead to delays in proper diagnosis and treatment.

It has long been reported that more males than females are diagnosed with ASD. Females are often underrepresented, misdiagnosed, or diagnosed later than males, which can negatively impact access to services (Barbaro & Freeman, 2021), specifically early intervention in which research has shown to have a positive shift in developmental trajectory and meaningful improvements for a wide range of skills areas (Barbaro & Freeman, 2021; Mozolic-Staunton et al., 2020; Sacrey et al., 2021). Although research has not consistently shown that gender differences are apparent in high-risk infants and toddlers, it remains imperative that parents are informed of subtle behavioral characteristics, especially if the infant is deemed to be at-risk based on family history circumstances. Currently, many children are not diagnosed until 4 years of age or older (Sacrey et al., 2021), even though symptoms can be detected with a high degree of confidence as early as 12 months (Mozolic-Staunton et al., 2020). This discrepancy between age for identification of symptoms and when a diagnosis is provided should be considered inadequate when research supports early intervention services before the age of 2 years.

Parents Raising Concerns and Screening for ASD

Expensive medical tests, which seek to identify biological markers (e.g., physical features of brain development), can be conducted at 6 months of age, during what is referred to as a "pre-symptomatic" period. However, these tests are costly and inaccessible to most families. The American Academy of Pediatrics suggests screening specifically for ASD between 18 and 24 months during primary care well checks as well as general developmental screening at 9, 18, and 30 months of age (Hyman et al., 2020). The oldest and one of the most used early screening measures is the Modified Checklist for Autism in Toddlers (M-CHAT; 16–30 months). Another popular measure, the Screening Tool for Autism in Toddlers and Young Children (STAT), is for infants aged 24–36 months. The CDC also recognizes several other more general developmental screeners with varying sensitivity, including the Ages and Stages Questionnaires (ASQ; 1 month to 5 years), Communication and Symbolic Behavior Scales (CSBA; 6–24 months), and Parents' Evaluation of Developmental Status (PEDS; birth to 7 years 11 months of age) (Centers for Disease Control and Prevention, 2020b).

General guidelines and toolkits have been created around the globe to help lead parents through the process of detecting concerns, assessing for diagnostic purposes, and accessing intervention services. Some include the Ambitious about Autism Parent Toolkit (Ambitious about Autism, 2021), National Guideline Implementation Toolkit (Cooperative Research Centre for Living with Autism, 2021), and the Autism Speaks First Concern to Action Tool Kit (Autism Speaks, 2021). Autism Speaks is an organization that provides research, advocacy services, and support to autistic individuals and the caregivers and professionals who assist and support them (Autism Speaks, n.d.). The organization has created a free, easily assessable First Concern to Action Tool Kit designed to educate caregivers on child development, discuss concerns with PCPs, and navigate the process of obtaining an evaluation (Autism Speaks, 2021). The tool kit lists "red flag" warning signs, described by clinicians as behavior and social communication markers, as well as specific months in which delays should be considered a significant concern warranting a discussion with a physician. The tool kit recommends scheduling an appointment with a PCP and requesting a developmental screener if the child is not meeting any of the milestones provided in the red flag milestone list. Furthermore, the tool kit provides a letter template for the healthcare provider and immediate access to the M-CHAT questionnaire, both of which can be brought on the day of the appointment.

More recent research continues to support parents as reliable sources who can identify social communication markers (e.g., limited eye contact) in high-risk infants, as early as 9 months of age (Sacrey et al., 2021). This insinuates that parents can be key to early detection if given the opportunity. Therefore, further development of ASD-specific screening measures for younger children that are completed by caregivers in addition to teaching parents how to better identify symptoms is a worthwhile cause. Not only would this approach be more accessible and cost-efficient to families worldwide compared to medical tests, but also it would likely lead to more children being properly evaluated and gaining access to intervention services earlier. However, to be successful, additional variations of these measures need to be modified to account for cultural diversity and social-economic backgrounds (Marlow et al., 2019).

Once a child has been identified as "at-risk" by the PCP or a parent continues to have concerns, those parents have several options, depending on access to resources. They can acquire a second opinion by another PCP or seek out an independent evaluation by a psychologist, neurologist, or another developmental specialist, which may or may not be covered by insurance. They can also request an evaluation from a public/state agency or local school district, with the caveat that there may be a lengthy waitlist. Parent resources, persistence, insurance, and socioeconomic status play a large role in this process. This course of action can often take weeks, even months, and costs and access to evaluation services will vary by state and country. Resources like the Autism Speaks First Concern to Action Tool Kit provide guidelines on what parents can be actively working on during the waiting period, such as gathering additional information on local services available, as well as providing evidence-based strategies to promote social communication and play skills (Autism Speaks, 2021).

Parent Involvement in the Evaluation Process

During the evaluation phase, parents again are the ones providing most of the information needed to properly assess the child's skills and to determine what level of support is needed. A thorough ASD assessment will often consist of interviews (i.e., parent, daycare provider, teacher), parent-completed questionnaires or an autism-specific caregiver interview (i.e., Autism Diagnostic Interview-Revised), direct observation, and ideally, the "gold standard" diagnostic measure (i.e., Autism Diagnostic Observation Schedule, Second Edition). Parent-completed questionnaires may be ASD specific, such as the Gilliam Autism Rating Scale, Third Edition (GARS-3), Childhood Autism Rating Scale (CARS2), Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), or The Autism Spectrum Rating Scales (ASRS). Or questionnaires can be more general and assess a wide range of behavioral, developmental, emotional, and adaptive skills areas such as the Behavior Assessment System for Children, Third Edition (BASC-3) or the Adaptive Behavior Assessment System, Third Edition (ABAS-3). For all these questionaries, clinicians are relying on and trusting the parent's ability to understand the items and to accurately rate their child's behaviors and skills. In many cases, language and cultural barriers can affect a parents' understanding of assessment questions (Marlow et al., 2019), so parents must be given a version in their primary language, and, if available, one with items created specific to their culture, or the use of a translator, if necessary.

Research has demonstrated with great confidence that ASD interventions have long-term developmental benefits. Koegel et al. (2014) reviewed the literature noting that with appropriate treatment in place, many children who have received evidence-based interventions participate in regular education classrooms, fewer than 10% will remain nonverbal, and approximately 25% will no longer meet the criteria for ASD once treatment is completed. Furthermore, there are also financial benefits correlated with intervention services for families of children with ASD and society (Mozolic-Staunton et al., 2020). Children receiving 3 years of early intervention before school entry were estimated to show a cost savings of up to one million USD per individual aged 3–55 years; however, without early intervention, symptoms are likely to go untreated, requiring more costly services to address these issues when the child is older (Koegel et al., 2014). Furthermore, involving parents as agents of change during early intervention services can produce additional gains in both child skill development, as well as improvements in parent self-confidence and mental health (Koegel et al., 2014).

History and Theoretical Foundations of Parenting Programs

The majority of parent training programs (PTPs) that are well established today were influenced by several psychological theories that developed between the 1950s and 1980s (Hasla et al., 2019). These theories helped shape the use of common strategies employed across most of the group and individual PTPs today.

In the early 1950s, B. F. Skinner's published his book, *Science and Human Behavior*, which discussed how human behaviors can be predictable and therefore controlled to an extent. Furthermore, it explains how specific social contingencies, also known as behavioral principles (e.g., antecedents, consequences, reinforcement, punishment), can be applied to several areas such as education, religion, and therapy (Skinner, 1953) to impact human behavior positively or negatively. Most PTPs now acknowledge how parent behaviors can impact a child's behavior and vice versa through these principles and therefore, by teaching parents how to modify their behaviors, PTPs can help create positive behavioral changes in their children. Teaching parents basic skills, such as offering choices, reducing initial demands, reinforcing compliant behaviors (e.g., with praise or tokens), or using a punitive consequence (e.g., a brief time out until the instruction is complete), can lead to improvements in the child's behavior. Moreover, these child developments are directly linked to positive, consistent, and immediate changes (e.g., antecedents, consequences) in parent behavior. For instance, if a child is attempting to gain a parent's attention inappropriately by yelling their name while the parent is speaking to a teller in the bank, the consequence they receive will lead to an increase or decrease in their future behavior of using yelling as a strategy to gain attention. If the parent stops talking to the teller, leads the child out of the bank, and provides the undivided attention the child seeks, the child will be more likely to yell inappropriately in the future. Whereas, if the child is ignored and redirected to an independent activity (e.g., asked to sit and draw), the child will be less likely to yell in the future because it did not result in gaining the parent's undivided attention.

Albert Bandura's theory on social learning models was published in the 1977 article, "Self-efficacy: Toward a unifying theory of behavioral change." In this research paper, Bandura defends a theoretical framework to explain psychological phenomena applicable beyond psychotherapy. One primary focus of this article, related to the development of PTPs, is how various modes of treatment can influence behavioral change. Bandura defined outcome expectancy as the individual's estimate that a certain behavior they engage in leads to definitive outcomes or consequences, whereas efficacy expectations are related to how confidently an individual believes that they can successfully engage in the behavior needed to produce the desired outcome. During and following treatment, an individual's perceived self-efficacy can impact motivation and the use of appropriate coping skills. Bandura (1977) further explains that by using various modes of induction during the treatment process, one can impact four different sources of information that will affect a client's perceived self-efficacy, thereby increasing the success of treatment gains. Variations of these modes of induction, noted in Fig. 22.1, are commonly used today during various forms of cognitive-behavioral therapy (CBT), ABA therapy, and parent training. Many PTPs today incorporate strategies such as modeling (e.g., in vivo, video), suggestion (i.e., words of encouragement, praise), desensitization (i.e., frequent practice opportunities), and relaxation techniques (e.g., deep breathing), that can increase self-efficacy and lead to greater treatment outcomes.

In 1982, G. R. Patterson's study and research of the coercion theory was published in his book, *Coercive Family Process*. His theory attempted to explain the variables that can account for an increase in or maintenance of aversive and aggressive behaviors during child and caregiver interactions. This theory reflects on aspects of social and cognitive-psychological variables, physiological components such as the responses of the automatic nervous system, and reinforcement theory. One aspect can be how consequences occurring after these aversive behaviors and events may lead to an increase or decrease in these behaviors. For instance, if a parent requests that the child clean up their room and the child ignores the request, the parent may then escalate their behavior by using a louder voice, harsher tone, or expressing other signs of frustration and irritability. The child may then respond to the parent's escalation by vocally refusing and engaging in tantrum behavior. This interaction may go back and forth multiple times until either the parent gives up or exhibits a more heightened variation of reactions (e.g., screaming, threats, corporal punishment) that cause the child to comply. If the parent gives in (i.e., removes or stalls the demand), then the child's heightened reaction using tantrum behavior has been reinforced and the next time, they may be more inclined to behave in escalated fashion from the start versus ignoring the parent (e.g., low level, less disruptive problem behavior).

Furthermore, if the child's initial reaction is to tantrum, then the parent's initial response to this may be to use screaming, threats, or corporal punishment from the start rather than expressing irritability and repeating the request. If the parent succeeds in getting the child to comply using the escalated reactions of screaming, threats, and/or corporal punishment (e.g., a slap), then these behaviors have now been reinforced and the parent will be more likely to use these initially in the future. The cycle of escalation can start with either the child or parent and the escalation may take weeks, months, or years to develop into a highly tumultuous pattern, but the escalation is likely to continue over time unless the parent or child learns different behavioral patterns. Patterson's coercion theory has influenced PTPs to focus on teaching parents positive behavior management strategies to alter this negative cycle (see Fig. 22.2).

There are multiple evidence-based PTPs worldwide, which all share common features.

Fig. 22.1 Major sources of efficacy information and the principal sources through which different modes of treatment operate. (From: Bandura (1977))

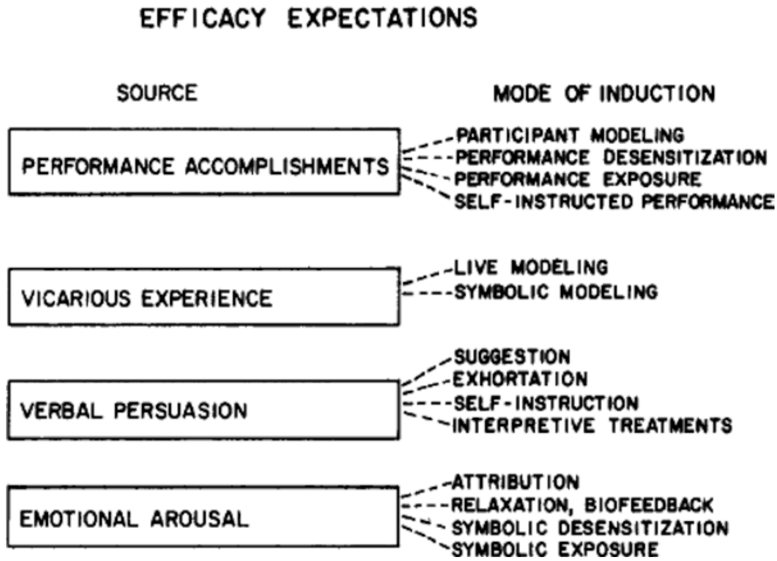
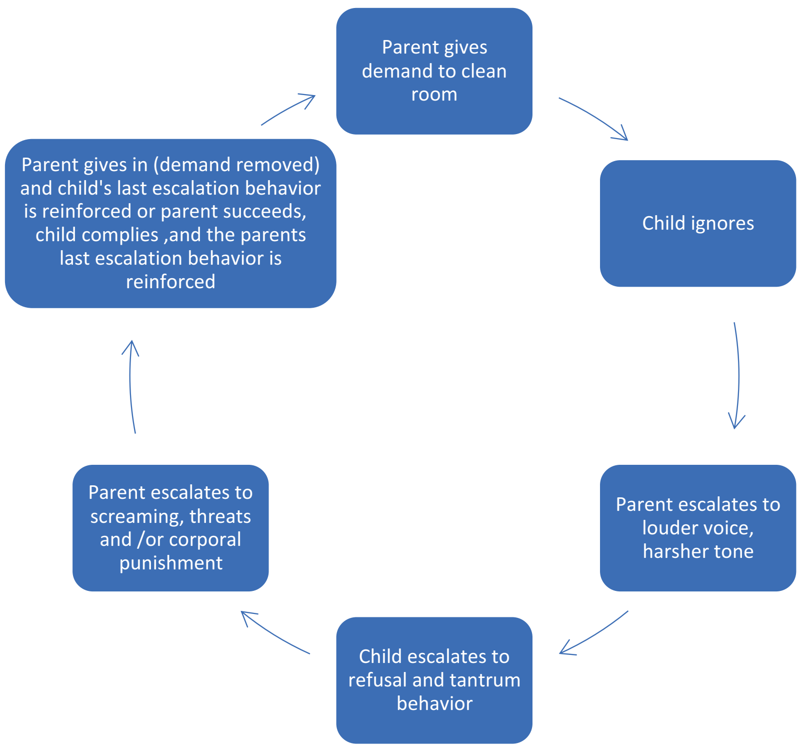


Fig. 22.2 An example of the coercive cycle that involves parent and child interactions when a demand is provided



PTPs in general seek to improve the caregiver–child relationships by teaching caregivers effective strategies to manage problem behaviors while strengthening relationships through boosting parental knowledge and reducing negative patterns of behaviors. Three of the more well-known programs are The Incredible Years (IY), Parent–Child Interaction Therapy (PCIT), and Triple P (see Table 22.1). All were developed over 40 years ago and have an abundance of research supporting their success. These three PTPs have been developed to be implemented

Table 22.1 Variation in parent training programs

Parent training program	Specific components	Duration of treatment	Auxiliary adjunct programs
The Incredible Years	Toddler basic (1–3 years)	13 weeks (2-hour group sessions)	School Readiness Program; Attentive Parenting Program; Autism Spectrum and Language Delays Program
	Preschool basic (3–6 years)	18–20 weeks (2-hour group sessions)	
	School-age basic (6–12 years)	12–20 weeks (2-hour group sessions)	
	Advanced (4–12 years)	9–11 weeks (2-hour group sessions)	Well-Baby Program
Parent–Child Interaction Therapy (PCIT)	PCIT with child-directed interaction and parent-directed interaction (2–7 years)	12–20 sessions (1-hour)	Group PCIT; Home-Based PCIT; Teacher–Child Interaction Training (TCIT); Infant Behavior Program; PCIT–Emotional Development; PCIT with Emotion Coaching; Intensive PCIT (I-PCIT); PCIT-CALM
Triple P	Level 1 (Universal Triple P)	High-impact communications campaign, not delivered directly to parents	Family Transitions Lifestyle; Stepping Stones; Indigenous
	Level 2	15–30 min consultations as needed provided by a practitioner who provides regular support or three 90-min seminars	
	Level 3	Four 15–30 min consultations as needed provided by a practitioner who provides regular support or up to four 2-hour group sessions	
	Level 4	5 group sessions and 3 follow-up consultants via phone, or one-on-one (10 one-hour sessions), or Internet-based service option/ self-help workbook/weekly phone consultations	
	Level 5 Enhanced Triple P; Pathways Triple P (Infancy to 2 years)	1–3 modules (ranging from three 40–90 min sessions) with a maintenance and closure session	
	Teen Triple P (12–16 years)	Three 90-min seminars	

with families struggling with maladaptive, problematic behaviors. Research on these programs continues to extend with more diverse populations such as individuals with autism and other developmental delays (Dababnah & Parish, 2014; Garcia et al., 2015; Ros et al., 2016) and high-risk and socially disadvantaged populations (Chaffin et al., 2011; Galanter et al., 2012; Furlong & McGilloway, 2015), as well as multicultural groups and individuals from various countries (Lieneman et al., 2017; Morawska et al., 2011). Additional research in the areas of low- and middle-income (LAMI) countries (Hastings et al., 2012; Puffer et al., 2015), programs for wider ranged, culturally diverse clients (Baumann et al., 2015; Hamdani et al., 2017), strategies tackling barriers to treatment (Lieneman et al., 2019), and research focused on component or parametric analyses (Lieneman et al., 2017; Pidano & Allen, 2015) are still needed. Regrettably, PTPs that are not funded by government agencies or reimbursed through insurance companies, come at a hefty price to the consumer (Pidano & Allen, 2015) and will not be made accessible universally until those involved in the development, service delivery work, and policymaking conclude and agree that the long-term outcomes for the child, family, and society, including financial benefits of these programs, are worth the short-term costs.

Behavioral parent training is considered the leading intervention for child behavioral issues (e.g., compliance, disruptive behaviors) that are linked to a wide range of psychopathologies. More than 100 publications over the last few decades, including meta-analysis reviews, have securely identified behavioral PTPs as evidence based and highly efficacious over time (Booth et al., 2018; Cohen et al., 2010; Kaehler et al., 2016). Research in this area demonstrates that parent participation among programs can differ significantly and that the teaching methods can include a variety of components. In the last few decades, parent involvement during treatment has risen as research shows that it can lead to long-term gains with maintenance and generalization of skills (Booth et al., 2018; Hsieh et al., 2011), as well as reduced parental stress and improvement in parenting skills (Schultz et al., 2011). Parents, or also referred to as agents of change, work with professionals who are focused on training them to deliver treatment to their children. Parent-implemented or parent-mediated programs are typically labeled as primary or complementary. Both are led by a key therapist who uses variations of modeling, role-play, and feedback or coaching to train the parent how to deliver a specific intervention with their child to enhance skill development in several settings (Bearss et al., 2015). However, with complementary parent-mediated programs, the lead therapist will work with the child first without direct parent involvement, and then use coaching strategies to incorporate the parent and transfer instructional control during the therapy session (Bearss et al., 2015).

There are various strategies used by professionals to train parents through PTPs or as part of an individualized program within an academic center (e.g., psychology department, early intervention program), or private setting (e.g., psychology clinic). These strategies may include providing verbal or written instructions, modeling the skills for the parent, using role-play, or coaching to allow the parent to rehearse the novel skills with a therapist or their child, and providing specific feedback to lessen errors and reinforce correct techniques. When these components are used together, it is referred to as Behavioral Skills Training (BST; see Table 22.2). The term BST was coined in the 1990s (Crane, 1995) and this training technique has been extensively researched and continues to be considered one the most effective and efficient methods of teaching new skills to parents specifically as well as to individuals of all ages with diverse diagnoses.

One primary issue within the BST research is the inconsistency with the use of all components. With researchers using variations of the components without systematically assessing them, it remains unclear what minimum number of components are required to achieve the strongest effects and what formats the components should be delivered in (e.g., written versus verbal instructions, video versus in vivo modeling). Three research studies in the 1980s suggested that instructions alone were insufficient to create behavior change (Ward-Horner & Sturmey, 2012) and within the last decade, three additional studies have conducted a component analysis of BST. Two articles noted that all four BST components were required for behavior change and skill maintenance (Davis et al., 2019; Drifke et al., 2017), and another stated that strictly feedback and modeling were demonstrated to be the most effective components (Ward-Horner & Sturmey, 2012). Of the six publications in this area, four were used to evaluate caregiver skills. Due to the high variability in populations, settings, and behaviors that BST can be applied to, it has affected researchers' abilities to draw strong conclusions regarding which components show the most efficacy overall. However, research in this area continues to grow and suggests an individualized approach may be more beneficial for some populations.

Table 22.2 Example of BST components used to teach the three-step prompting procedure

Technique	Description	Example
Instruction	The clinician provides a rationale to the learner, either verbally and/or in written form for why a skill is important to learn	The clinician gives the parent a handout on the three-step prompting procedure and explains how this prompting strategy will help lead to an increase in child compliance
Model	The novel skill is modeled for the learner to demonstrate what the skill looks like visually	The clinician models the three-step prompting procedure with the child in front of the parent; correct and incorrect strategies would be used to help the parent discriminate what this skill does and does not look like
Rehearse	The parent is given the opportunity to practice using the new skill either during role-play with the clinician and/or in vivo as part of coaching	The clinician may first role-play the three-step prompting procedure with the parent while switching roles of who plays the child; following, the clinician may watch the parent practice with the child through a one-way mirror or via telehealth, using a bug-in-the-ear device
Feedback	Labeled (i.e., behavior specific), unlabeled praise, corrective criticism, or a combination is provided to the parent to praise and reinforce correct skill demonstration or to remediate incorrect performance	During or following the role-play or coaching, the clinician will provide positive comments about what the parent did correctly (e.g., "Nice job giving a clear, specific instruction") and corrective feedback on parent errors (e.g., "I noticed when your child complied right away, you forgot to praise him/her for being a good listener; let us try this again giving praise for the behaviors we like to see")

Sleep Issues

Infant sleep problems affect up to 25% of the population and cause significant stress for parents (Field, 2017). The CDC (Centers for Disease Control and Prevention, 2018) reports that six in ten middle school students and seven in ten high school students have insufficient sleep. Research has also shown that poor sleep hygiene over long periods of time can increase the risks of serious health issues such as obesity and diabetes as well as contribute to challenges with academics, attention, and behavioral problems (Centers for Disease Control and Prevention, 2018). Additionally, sleep problems are also associated with psychological disorders such as attention-deficit/hyperactivity disorder (ADHD) and have a bidirectional link with symptoms associated with anxiety and depression (Bourchtein et al., 2020; Hunter et al., 2020). Approximately 80% (Hunter et al., 2020; McLay et al., 2018) of children with ASD also experience sleep issues, most commonly with resistance to bedtime routines, night waking, unwanted co-sleeping, and reduced total sleep time (Kirkpatrick et al., 2019; Vriend et al., 2011). Sleep deprivation for children with ASD can lead to an increase in other problematic behaviors (Johnson et al., 2018; Mazurek & Sohl 2016; McLay et al., 2018; Vriend et al., 2011) such as aggression, noncompliance, deficits in daily living skills (Kirkpatrick et al., 2019), hyperactivity, self-injurious behaviors, as well as contribute to distressing parent consequences (e.g., fatigue, depression, heightened stress) (Hunter et al., 2020; Kirkpatrick et al., 2019). Furthermore, some studies have shown that sleep issues can be a chronic condition (Johnson et al., 2018) lasting into adulthood (Goldman et al., 2017).

Sleep interventions are categorized as pharmacological, behavioral, or a combination of the two. Since most behavioral interventions occur in the home setting during nonworking hours, parents, as agents of change, need to be trained to apply strategies that they find manageable to implement. Simplistically, behavioral interventions for sleep issues have focused on decreasing parent–child behaviors that are incompatible or disadvantageous to sleep (e.g., unwanted co-sleeping) while also increasing those parent–child behaviors that can improve sleep (e.g., creating a healthy sleep routine). Common intervention techniques taught to parents of children exhibiting sleep problems have often included a multi-element approach using a combination of psychoeducation about sleep hygiene, relaxation strategies, limiting stimuli or activities that affect sleep such as caffeine and access to electronics (Bourchtein et al., 2020), positive, consistent bedtime routines, scheduled waking routines, reduction in day time napping (Carr, 2019), graduated extinction (e.g., increasing intervals between comforting the child) (Vriend et al., 2011), and bedtime fading (e.g., gradually making bedtime earlier) (Field, 2017; Kirkpatrick et al., 2019). It should be noted that professional support and delivery can impact treatment. For instance, similar benefits have been found for group versus individual formats and session durations that range from 2 to 5 weeks. However, hands-on (e.g., clinician-led modeling or role-play) may be more beneficial than written materials (Kirkpatrick et al., 2019). It is also important to note that some of the child-focused interventions temporarily have led to an increase in maladaptive behavior by the child in the form of extinction bursts (e.g., when the child is no longer permitted to stall bedtime), which can be particularly challenging for parents. Therefore, it is essential that clinicians and behavior analysts fully inform parents of what to expect during the intervention process and empower them with education, realistic expectations, and proper training, to increase the likelihood of success.

In the last 20 years, several systematic reviews have been conducted that have demonstrated that parent-mediated interventions for sleep are not only effective but also produce longer-lasting results compared to pharmacological interventions alone (Carr, 2019). In a recent review of nonpharmacological interventions for sleep with school-age children, results indicated that behavioral parent training was particularly beneficial for children with various forms of psychopathology including ADHD (Bourchtein et al., 2020) and those individuals with developmental disorders (Kirkpatrick et al., 2019). Behaviorally based sleep interventions in the home have also produced collateral benefits to treatment, such as positive changes in other behaviors or symptoms not directly targeted as part of the intervention (e.g., stereotypical behaviors, internalizing symptoms) (Hunter et al., 2020). More recent research in this area has focused on health and safety issues related to child sleep problems. Carrow et al. (2020) used BST to teach caregivers how to reduce the risk of sleep-related, sudden unexpected infant deaths (SUIDs) caused by harmful environmental arrangements (i.e., laying infant on stomach with face down, use of soft bedding). Parents in this study were taught how to use appropriate materials and arrange the sleep environment in a way that keeps the infant safer. Similarly, in a case study with a six-month-old infant with moderate obstructive sleep apnea, Voulgarakis et al. (2017), using an ABA reversal design, applied antecedent manipulations (i.e., relocation of certain stimuli) and noncontingent social reinforcement to increase the use of a lateral sleeping position.

Recent research, specific to the ASD population, has an assortment of diverse populations and treatment methods. One study examined a brief (i.e., 2 sessions) intervention for adolescents aged 11–18 years to improve sleep hygiene (Loring et al., 2018). Another compared group (two, 2-hour sessions) versus individual (one, 1-hour session) delivery format of a sleep education curriculum (Malow et al., 2014). In another comparison study, many families (i.e., a sample of 40) participated in a randomized clinical trial (RCT) where they were randomized into a behavioral parent training program or a nonsleep-related parent education group (Johnson et al., 2013). Results indicated that a five-session program was provided, and it was proposed that behavioral parent training program had significantly more parent-reported improvements with robust effect sizes at 4 and 8 weeks. McLay et al. (2018) had seven families participate in a functional behavior assessment (FBA), which later contributed to an individualized behavioral treatment plan utilizing a multi-component intervention (i.e., social story, fading procedures, planned ignoring, positive reinforcement, Gro-clock) to address the sleep behaviors of children with ASD aged 2–5 years. Although two children dropped out during the study, overall results demonstrated a decrease with reactive co-sleeping and high satisfaction ratings by parents. In another comparison study, Roberts et al. (2019) compared an online and group parent education program. Both consisted of two, 2-hour sessions either as interactive workshops or online podcast sessions with a blogging option. The educational program was modeled from prior research and the book *Solving Sleep Problems in Children with Autism* (Katz and Malow, 2014). Although only 52% of parents completed the online program and 76% finished the face-to-face option, results demonstrated that both programs showed parent-rated improvements in child sleep behaviors and parent quality of life (Roberts et al., 2019).

In a 2021 feasibility study, MacDonald et al. (2021) held a multi-session, community-based program that consisted of a previously published curriculum and associated materials (i.e., time log, visual supports, homework, actigraphy). Preliminary findings were positive and suggestive that community therapists who are trained by academic professionals can effectively be taught to provide parent training and education services, therefore increasing access to treatment for larger populations. In 2017, Goldman and colleagues took a novel approach by assessing both parent and child self-report measures along with physiological measures to compare the sleep behaviors of adolescent/young adults with ASD and a typically developing peer group. The results of the study found that individuals with ASD reported more difficulty falling asleep and displayed longer sleep latency compared to typically developing peers. Although no clear explanation was examined, it was proposed that most autistic individuals reported an earlier bedtime, which may have impacted their struggle with falling asleep. This early bedtime may have been related to medication side effects, less social obligations to stay in contact during the evening with peers, or parents setting stricter bedtime curfews compared to parents of typically developing peers (Goldman et al., 2017). In addition, a large RCT was conducted in 2015 with over 200 participants investigating the effects of a sleep intervention on infant behaviors (Hall et al., 2015). The intervention targeting parent cognitions and behaviors consisted of one 2-hour session and bi-weekly telephone sessions for 2 weeks led by nurses. Information was provided on normal infant sleep habits and routines, strategies parents could implement to better manage sleep issues, and an educational video of infants in various stages of sleep. Researchers found that compared to the control group, families who received the multicomponent intervention had a reduction in child night wakenings, increases in night sleep duration, and improvements in parents' beliefs and expectations about infant sleep behaviors (Hall et al., 2015). Lastly, current research also continues to support the use of specific parent-mediated interventions such as bedtime fading and establishing healthy, positive sleep routines (Delemere & Dounavi, 2018; Sanberg et al., 2018). Delemere and Dounavi (2018) analyzed secondary outcomes and noted that parent-delivered behavioral interventions can both positively impact learning opportunities and decrease challenging behaviors, but not consistently for all individuals. Malow et al. (2014) also noted secondary treatment gains in repetitive behaviors as well as parent quality of life and competence as measured by parent-completed questionaries.

Given the prevalence and substantial negative impact, both with short- and long-term effects on clients and their families, additional research in the area of ASD and sleep issues should continue to evaluate treatment fidelity, stimulus control interventions (Delemere & Dounavi, 2018), long-term maintenance of skills (Kirkpatrick et al., 2019; Loring et al., 2018), collateral effects of treatment (Bourchtein et al., 2020; Hunter et al., 2020), and treatment delivery selections (Johnson et al., 2013; Malow et al., 2014). In addition, research with more well-controlled methodologies (Vriend et al., 2011), component analysis of multi-component interventions (McLay et al., 2018), and larger sample sizes (Johnson et al., 2013; Sanberg et al., 2018) should be investigated. Sleep issues, regardless of diagnosis, can be long lasting, and symptoms may not decline with time naturally. This is a primary reason why young children with ASD should be a key population to screen and be provided with early access to treatment.

Communication

According to the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-V*), communication disorders fall under the categories of language disorder, speech sound disorder, childhood-onset fluency disorder (stuttering), social (pragmatic) communication disorder, as well as other specific and unspecified communication disorders and these affect variations in speech, language, and communication skills (American Psychiatric Association, 2013). Although prevalence rates are unclear for many of these communication disorders, research has indicated that a language disorder untreated after age four will likely persist into adulthood, and children with receptive language impairments compared to expressive deficits are more resistant to treatment. Furthermore, the *DSM-V* states that children diagnosed with speech sound disorder tend to have a better prognosis, and typically respond well to treatment. Individuals with childhood-onset fluency disorder typically express these verbal challenges by 6 years of age but onset can vary between ages 2 and 7 years and 65–85% significantly improve. Individuals with social (pragmatic) communication disorder display challenges with the social use of both verbal and nonverbal communication abilities that appear as atypical from an early age (i.e., 4–5 years old) although those with milder forms may not be identified until adolescence. Without treatment, social (pragmatic) communication disorder can have a lasting negative impact on social relationships and behaviors. Finally, other specific and unspecified communication disorders are provided when symptoms are considered clinically significant but do not meet criteria for one of the primary categories as previously noted (American Psychiatric Association, 2013). Since age is a predictor of long-term prognosis for communication disorders, as well as correlated with other academic skills and behavioral issues (Heidlage et al., 2020), early interventions with parent involvement are imperative.

A core symptom of ASD includes deficits in social communication. This can include challenges with social engagement, language, communication, as well as play skills (American Psychiatric Association, 2013). When an individual has multiple skills deficits, compared to only one language disorder, the impairments in social communication can negatively impact the usefulness of typical parent–child language interactions that would normally boost language learning (Heidlage et al., 2020). Research has also shown that there are long-term negative outcomes if deficits in social communication abilities persist (Pacia et al., 2021). In a review of the literature for parenting interventions with children diagnosed with ASD, most focus on communication as the primary target behavior (Bearss et al., 2015). Common targets for parent-mediated interventions include teaching parents how to modify their actions to facilitate language learning. This includes responding to bids for attention, using the child's interest in activities or items to model and assist in expanding language, responding to variations in vocalizations to reinforce specific sounds, and using naturally occurring routines or play activities to motivate the child, as well as embedding more frequent opportunities for the child to practice using desired forms of communication (Heidlage et al., 2020). Common procedures based on ABA include shaping, modeling, incidental teaching, as well as echoic, mand, tact, and intraverbal training. Discrete trial teaching (DTT) and functional communication training (FCT) are often incorporated into part of structured Naturalistic Developmental Behavioral Interventions (NDBI) programs (Bearss et al., 2015; Gevarter et al., 2021). These programs share a common goal of using natural learning opportunities within a meaningful and developmentally appropriate context (Akemoglu & Tomeny, 2021) and may include, but are not limited to, Early Start Denver Model (ESDM), Joint Attention, Symbolic Play, Engagement, and Regulation (JASPER) (Sengupta et al., 2020), and Pivotal Response Treatment (PRT) (Bearss et al., 2015). These programs and training strategies encourage and teach parents how to use daily ordinary opportunities to not only increase the dosage of the intervention (e.g., from the clinic services only to home-based training as well), but also promote generalization of child skills (Ingersoll & Wainer, 2013).

Recent literature focused on the ASD population has investigated the effects of specific training programs such as naturalistic communication training (NCT) and FCT to improve communication skills. Akemoglu and Tomeny (2021) used coaching to teach parents how to implement shared-reading activities and skills associated with NCT (i.e., modeling, mand-model, and time delay) to increase preschool-level children's communication skills with strong parent fidelity. In another study with Latinx families, investigators, using a nonconcurrent baseline design, explored the effects of implementing one training session plus two coaching sessions to improve parent communication turn-taking skills and the independent responses of their children (Gevarter et al., 2021). Results demonstrated that this brief intervention had positive outcomes on the parent's behaviors as well as the child's during and following the removal of provider support. FCT is a primary intervention for teaching communication while working to reduce problematic behaviors and is recognized as an evidence-based intervention for children with ASD (Gerow et al., 2018). The goals of FCT are to first identify the function of the challenging behavior and then teach a replacement communication response that serves the same function. While teaching this skill, the agent of change would reinforce the alternative communicative response while withholding reinforcement in the presence of the problematic behavior. In a review specifically of parent-mediated FCT, Gerow et al. (2018) found that few studies discussed the degree of parent involvement in the development of interventions, which may be a result of imitation, cookie-cutter programs in which the same approach or style is consistently used, and not enough attention being paid to individual differences. On a positive note, an individualized intervention that takes parent preference and family routine into account could have larger outcome benefits (e.g., higher treatment fidelity and maintenance of strategies). Overall, parents reported high satisfaction and acceptability with the FCT parent-mediated program. FCT has also been found effective when delivered by parents with remote (Simacek et al., 2017) and real-time online coaching (Lindgren et al., 2020). In a novel RCT of FCT, researchers found that the intervention reduced problem behaviors while increasing manding and task completion skills as well as being highly acceptable by parents (Lindgren et al., 2020).

Reviews of the literature have demonstrated the positive effects of parent-mediated language interventions for both parent and child skills; however, effects may be more robust for certain skills such as expressive compared to receptive vocabulary (Heidlage et al., 2020). In a systematic review, Pacia (2021) determined that research in this area has focused on mothers being the primary agent of change and that sibling-mediated interventions still required additional research with stronger methodologies. In addition, interventions of 20 hours or less, compared to higher dosages, tended to show similar outcome benefits. Research has also shown the benefits of parent-implemented programs for communication using the Picture Exchange Communication System (PECS) and BST targeting acquisition of verbal scripts (Matson et al., 2012b) as well as using BST to train parents to implement strategies during play to improve child mands (i.e., requests) and tacts (i.e., labels) (Pisman & Luczynski, 2020). Telehealth options including videoconferencing, websites, apps, and self-paced videos using BST have also shown similar treatment effects compared to face-to-face interventions. In addition, studies have expanded previous support for NDBI programs such as PRT with toddlers as young as 12 months who exhibit signs of ASD (Bradshaw et al., 2017), interventions with minimally verbal school-age children (Shire et al., 2015), non-US-based populations (Eid et al., 2017a, 2017b) with an active control group (Valeri et al., 2020), and community-based service delivery models (Ingersoll & Wainer, 2013; Smith et al., 2015a). Many studies in this area are still conducted in a clinical setting rather than in the family's natural environment with usual stimuli (e.g., items found in the client's home). Erturk et al. (2020) expanded research in this area by revealing additional promising data on both parent and child behaviors (i.e., caregiver fidelity, child communication skills) when training takes place in the home with natural stimuli; however, additional research comparing the two settings would be useful.

In conclusion, further research is still needed on parent involvement in the development of interventions (Gerow et al., 2018), the dosage of treatment and fidelity (Heidlage et al., 2020), and programs adapted for low-resource, culturally diverse settings (Sengupta et al., 2020). In addition to more research on collateral effects, incorporating other family members or both parents as primary agents of change (Pacia et al., 2021), and long-term outcomes of skills (Gevarter et al., 2021; Valeri et al., 2020), especially with the ASD population, it is also suggested future researchers working with the ASD population use an active control group compared to "treatment as usual" to ensure all families receive an intervention they can benefit from (Lindgren et al., 2020; Valeri et al., 2020).

Feeding

When a child's feeding behaviors have an adverse effect on their physical or psychosocial functioning, it is deemed to be a clinically significant issue, requiring treatment (Lukens & Silverman, 2014). Most pediatric disorders have symptoms that include self-feeding challenges, problems with swallowing, excessive vomiting, food selectivity and refusal, disruptive behaviors associated with feeding, and, in life-threatening cases, failure to thrive. These issues impact approximately 25–40% of children (Murphy et al., 2020). Interventions focused on behavior analytic procedures include prompting, shaping, using reinforcement to increase appropriate feeding behaviors (Carr, 2019), escape extinction, stimulus fading (Alaimo et al., 2017), use of the Premack principle, and noncontingent reinforcement (Najdowski et al., 2010). Children with ASD are at a greater risk of having feeding issues with research estimating that possibly 80% may meet criteria in their lifetime for a feeding disorder. Chronic feeding issues can lead to harmful nutritional deficits (Johnson et al., 2015) because as food refusal behaviors may decrease, one's food repertoire does not necessarily increase (Bandini et al., 2017). Behavioral feeding programs have been identified as an effective form of treatment (Carr, 2019; Lukens & Silverman, 2014), and in most cases, although the primary intervention begins in a clinic or hospital setting, parents play a large role in maintaining and generalizing skills. Research in this area supports interventions initially led by a trained professional, followed by caregiver implementation as well as interventions where the caregivers are the primary agent of change (Alaimo et al., 2017). In most of these studies, a variation of BST was used to train the parents.

Researchers have been expanding the literature in a variety of ways including adaptations in protocols, settings, and studies including larger sample sizes to further the evidence in support of parent-mediated feeding programs. In 2010, Najdowski and colleagues used an exclusively home-based program to train parents how to apply differential reinforcement of alternative behavior (DRA) combined with nonremoval of the spoon and demand fading to improve children's food selectivity. Similarly, Taylor et al. (2019) developed a home-based behavioral program for children with long-term tube dependency that was effective in producing improvements with oral intake and tube feeding cessation. Researchers have also evaluated procedures of escape extinction and investigated the effects of using a Nuk brush as a replacement for a physical guidance strategy, which involves putting pressure on the individual's mandibular joint (Kadey et al., 2013). Alaimo et al. (2017) used a BST parent training program as well as general-case training (GCT) to successfully teach caregivers how to implement a feeding program for their child, and data revealed maintenance and generalization of target skills. In addition, a complete BST program was used to successfully train three parents of children with ASD to use several strategies as part of a taste exposure intervention

(Seiverling et al., 2012) and a seven-component expansion of BST was used to effectively train parents in using prompting procedures, escape prevention, and re-presentations of expulsions to improve child mealtime behaviors (Pangborn et al., 2013). Two simplified BST variations, including only written instructions as well as corrective and positive feedback interventions, have been used to improve the implementation of feeding protocols (Aclan & Taylor, 2017; Bachmeyer-Lee et al., 2020). Lastly, in 2019, Johnson and colleagues completed the first RCT of an individually delivered, nutritionally informed parent training program to address the feeding behaviors of autistic children. This study produced high adherence, parental satisfaction, low attrition, as well as improvement in child behaviors.

Future studies can continue to extend the research to further compare home and clinic-based training programs (Taylor et al., 2019), parent-mediated home-based education, training for less severe feeding issues (Sharp et al., 2014), RCTs (Johnson et al., 2015), as well as assessing interventions for adipsia, rapid eating, and self-feeding (Alaimo et al., 2017). In addition, an area lacking investigation includes expansion of food repertoire once food refusal has been addressed to limit the likelihood of nutritional issues during adolescence and adulthood (Bandini et al., 2017). There also remains limited research on parent-mediated feeding programs with culturally diverse patients and feeding interventions in low-income countries (Adams et al., 2011).

Safety

Child safety is a crucial issue worldwide. Accidents (i.e., unintentional injuries), not linked to medical issues, are the leading cause of death in the United States for children four to 9 years of age. Pedestrian injury is one of the highest-ranking causes of death for children, and children with disabilities are two to three times more likely to be killed in a pedestrian accident and far more likely to be struck by a vehicle than their typically developing peers (Harriage et al., 2016). In addition, child abduction cases are on the rise globally, and over 70% of victims are not returned safely to their caregivers (Ledbetter-Cho et al., 2021). Children with disabilities are a very vulnerable population and can be three times more likely to be abused (i.e., intentional injuries) compared to their neurotypical peers (Kenny et al., 2013). Regrettably, many children with ASD will not learn the necessary and appropriate safety skills without being specifically trained. Research on behavioral interventions to address safety skills has been published on a wide number of targets including fire alarm evacuation, pedestrian street crossing, hazardous situations, responding appropriately to a doorbell, sexual risk and abuse prevention (Summers et al., 2011), abduction-prevention skills (Ledbetter-Cho et al., 2021), and gunplay-prevention skills (Dogan et al., 2017). In most of these studies, children were taught these novel skills using BST by a clinician or behavior analyst.

Interventions targeting safety skills in recent research have been more limited than other skill areas for the ASD population. Using a simplified BST package, Summers et al. (2011) provided a home-based intervention for six participants with ASD. Half of the children were taught safety skills related to the doorbell and the other half on how to safely respond to chemicals. Results demonstrated positive gains in child skills; however, parents were not taught how to teach the skills, and therefore generalization opportunities in which a behavioral therapist was not present were not tested. In a similar study, BST was used to teach abduction-prevention skills that included a vocal decline (e.g., saying "no"), immediately leaving the area, and reporting the incident to an adult (Ledbetter-Cho et al., 2021). The participants were all children with ASD who had limited communication skills and were successful in learning the skills but several required booster sessions, which is to be expected, since natural practice opportunities are absent, and parents were not the agents of change. Yet, researchers noted that parent-mediated booster sessions could have contributed to stronger maintenance results. Other research for autistic individuals has focused on general safety skills and body safety as part of a case study (Kenny et al., 2013) as well as pedestrian skills training (Harriage et al., 2016). In a parent-implemented study, three parent–child dyads (i.e., two adolescents and one young adult, all with ASD) participated as part of in situ pedestrian skills training using the most-to-least prompting procedure (Harriage et al., 2016). This intervention was successfully executed by the caregivers; however, generalization of nontrained skills was either not observed or successful in novel settings without specific training.

More research in this area is needed, specifically focused on children with disabilities who have a broader range of communication skills with their parents serving as the agents of change. Teachers should also be included in future studies and encouraged to add safety skill goals to children's Individualized Educational Plans (IEPs). If skills are taught at school, reviewed during the IEP, and the interventions are parent-implemented at home, then it will likely increase maintenance and generalization of novel skills (Sirin & Tekin-Ifta, 2016).

Social Skills

Deficits in social communication and social interaction are core symptoms of ASD (American Psychiatric Association, 2013); therefore, much of the research with this population has focused on evolving these skill sets. Researchers have investigated various training protocols on improving nonverbal behaviors, empathy, discriminating between appropriate and inappropriate comments, leisure activities (Matson et al., 2012b), joint attention, imitation, and play skills (Beaudoin et al., 2019). However, few studies have measured long-term gains, explicitly in friendship development (Mandelberg et al., 2014). Furthermore, although there are a plethora of articles published on clinic-based, therapist-led group social skills programs, many of which are manualized or supplementary to a PTP for children with behavioral issues (Mandelberg et al., 2014), there are few that are parent implemented.

In a 2014 study, researchers investigated the long-term gains of a parent-assisted, manualized program on both specific behavioral targets and assessment of friendship development years later. Mandelberg et al. (2014) found long-term gains including the development of friendships that existed 2–3 years following the Children's Friendship Training (CFT) program, a 12-week parent-assisted social skills intervention for children aged 6–11 years. Another investigation of the CFT program with ASD participants focused on families living in Malaysia and found that children made gains in several areas such as social cues, and a decrease in friend-disengage and friend-conflict behaviors, but there were many parental barriers to treatment (Ong et al., 2021). For instance, this parent population reported diverse experiences with the CFT program including challenges with time dedication requirements, learning the novel skills, and other culture-specific traits from their collectivist society, which negatively impacted this Western, manualized program.

BST has also been used to train caregivers in how to support social skills development. Hassan et al. (2018) used BST with and without in situ training and found that during BST alone, all caregivers demonstrated 100% accuracy of skills taught following training, but they struggled with generalizing skills with their child. However, with the addition of in situ training, parent accuracy increased as well as child skill ability. Similarly, Dogan et al. (2017) assessed the effects of BST on teaching parents of children with ASD to be social skills trainers themselves. Results demonstrated that BST was effective in teaching parents to use the same BST intervention to train and implement social skill instruction with their children. Furthermore, parents maintained their abilities and were able to generalize their skills to training novel social skills with their children (Dogan et al., 2017). In other parent-mediated interventions, a computer game adaptation of a social skills program showed not only improvement with social skills, but the intervention also resulted in financial and geographical benefits (Beaumont et al., 2021). Video-modeling and feedback strategies were used to successfully train parents to implement peer-to-peer mand training (Madzharova & Sturmey, 2015), as well as a parent-implemented play date intervention for children with ASD, which showed mixed results for gains in joint engagement with peers (Raulston et al., 2021).

Rather than a clinic or home-based program, some researchers have also focused on the school setting. In one study, researchers conducted a large systematic investigation of a manualized program that was delivered to small groups of autistic children in the school setting by trained counselors (Ratcliffe et al., 2014). Additionally, as part of another school program, during a 16-week, school-based intervention (i.e., Program for the Education and Enrichment of Relational Skills—PEERS), students with ASD were evaluated on specific skills during a monthly reoccurring "game day" that included unstructured play periods with board games. Raters directly observed skills by viewing videos of "game day" and evaluated behaviors associated with vocal expressiveness, gestures, affect (e.g., emotion or mood), sportsmanship, and negotiations, among others. Researchers found that five out of six students showed statistically significant improvements (Bent et al., 2021). The PEERS program was also successfully translated, culturally adapted, and evaluated in an RCT hosted in a community setting with adolescent students in Hong Kong (Shum et al., 2019). In a highly unique article, Doenyas (2016) proposed a novel living complex housing families of children with ASD as well as those with typically developing peers to increase social opportunities for the children and to decrease the psychological burden experienced by parents due to isolation. The author proposed a 1-year program at this complex, which also provides peer-mediated social skill interventions, monthly supervision, and support groups for parents, with full-time residents including graduate students as well as outsourced specialists. Finally, as part of an RCT, 122 preadolescent, high-functioning children with ASD participated in a study comparing the outcomes of three groups; care-as-usual (CAU), SST (i.e., behavioral, manualized program over 15 weeks plus 3 booster session group sessions 2–6 months later), and SST-PTI (i.e., parent, teacher involvement plus SST) (Dekker et al., 2019). Although teachers reported improvements for those who participated in the SST-PTI compared to the CAU and SST, no statistically significant gains were made between the three groups on the trained social skills.

The clear goal of a social skills programs is to improve a wide range of skills for the individual that maintain outside of a clinic setting beyond the training protocol. Therefore, future studies must continue to assess friendship development following interventions (Mandelberg et al., 2014), the use of technology with remote options (Beaumont et al., 2021; Mairena et al., 2019), teacher involvement (Mairena et al., 2019), identification of subgroups of individuals with ASD (Dekker et al., 2021), agents of change who may need more individualized programs (Dubreucq et al., 2021), and generalization of skills (Hassan et al., 2018; Radley et al., 2014). In addition, infants and young children should be a target population for teaching early, formative social skills. In one study, children at risk for ASD, as young as 12–30 months, participated in a parent-mediated 12-week group program and results exhibited promising effect sizes but no statistically significant outcomes, suggesting that more research is needed with this age group (Beaudoin et al., 2019).

Daily Living Skills

Although children with ASD can make substantial gains with early intervention, adaptive skills can still be a challenge and can limit independence long term and cause a substantial burden for families. Daily living skills, also referred to as adaptive skills, can include teaching abilities related to household chores or routines, such as making the bed or washing dishes as well as self-care (e.g., brushing teeth, bathing, handwashing), healthcare (e.g., tending to minor injuries), money management, work, vocation, and independent living skills (e.g., meal preparation, buying groceries). Adaptive behavior is defined as the typical performance of daily activities and is not determined by actual ability or cognitive functioning (Bal et al., 2015). So, even if an individual has average cognitive functioning regardless of whether they have a disability, he or she may still require assistance and interventions in this area. Although a higher IQ is a very strong predictor of adult daily living skill outcomes, individuals with ASD will make gains into adolescence, but skill development may plateau in young adulthood (Bal et al., 2015).

ABA has already been shown to be an effective treatment for teaching adaptive skills. Teaching strategies based on ABA principles have included video prompting, task analysis, verbal and physical prompts, video prompting with error correction, feedback, and reinforcement procedures (Reitzel et al., 2013). Many articles only measure changes in adaptive skills based on parent-report questionnaires; however, in the last couple of decades, researchers have targeted specific observable skills such as table setting, sorting laundry, putting away groceries, and dental hygiene (Reitzel et al., 2013). There have also been many publications on the topic of toilet training with variations of Foxx and Azrin's method (Matson et al., 2012b). More recently, Allen et al. (2015) successfully used a parent-created video self-monitoring intervention to improve daily community living skills, specifically requesting help, checking out at a grocery store, and ordering food, for an autistic 17-year-old with a comorbid intellectual disorder. Cruz-Torres et al. (2020) trained parents to implement BST with continued coaching to prepare and teach their autistic adolescent child a daily living skill (i.e., making the bed, tying shoes, and making pasta) using a video prompting procedure. Participants were between the ages of 12 and 17 years, living at home with their caregivers. The parent intervention consisted of only one single-day session that included didactic instruction, modeling of the procedure, and opportunities for practice and feedback. In addition, the primary researcher went to each family's home three times a week to provide coaching for the duration of their participation in the study. Lastly, Yakubova and Chen (2021) used parent-implemented video prompting to teach a 14-year-old with ASD to confirm an appointment, floss, and fry an egg.

However, compared to other skill areas, most daily living skills have been unaddressed or limited in the research, which is highly unfortunate, because daily living skills play such a key role in one's quality of life. Few studies have investigated training methods for job tasks for employed adults with ASD. Due to higher unemployment rates of individuals with ASD, more research is needed to investigate supported employment and training methods (Matson et al., 2012a). Like other skills areas, assessment of training daily living skills in LAMI countries or low-resources areas using telehealth is also indispensable.

Specific Training in ABA Skills Procedures and Tools

An area significantly lacking in research is training caregivers to implement specific ABA instructional techniques and technology to help support skill development. Some of the areas investigated have been activity schedules and functional analysis (FA) (Halbur et al., 2020), along with specific training protocols to improve language and communications skills. For instance, Gerencser et al. (2017) used an interactive computerized training (ICT) self-paced program to train caregivers to successfully implement a photographic activity schedule with their autistic child. Parents in this study did not require performance feedback to achieve proficiency and they also were able to maintain strong integrity levels. High levels of satisfaction were also self-reported by parents suggesting ICT may be a cost-effective way to teach parents specific skills.

FCT, as previously mentioned, has been used as part of parent-mediated training programs (Gerow et al., 2018; Lindgren et al., 2020; Simacek et al., 2017) to increase communication skills and decrease problematic behaviors. DTT is a procedure that includes instructions, prompts, and reinforcement to improve skill development with confident support in training individuals using telehealth technology. Researchers have conducted studies demonstrating that caregivers and teachers are highly capable of implementing DTT protocols to teach children new skills (Eid et al., 2017b). For instance, Subramaniam et al. (2017) worked with families in rural areas with limited access to resources and direct care. As part of an in vivo BST program with supplemental video conferencing, parents of autistic children were trained to implement a DTT protocol and, additionally, to generalize those skills. Similarly, parents in countries with limited access to services have been taught to implement DTT protocols for children with ASD in Saudi Arabia (Eid et al., 2017b) and northern Brazil (e Silva et al., 2019). Researchers have also focused on training parents to implement incidental teaching protocols using a brief BST package (Hsieh et al., 2011) and training interventionists, who are not caregivers, to use incidental teaching with preschool autistic preschoolers (Neely et al., 2016). Moreover, in a unique study incorporating the importance of parent preference rather than just parent fidelity, researchers trained four parents to implement least-to-most, progressive-prompt delay, and most-to-least procedures to mastery (Halbur et al., 2020). Parents in the Halbur et al. (2020) study selected the least-to-most procedure as the high-preference intervention and the most-to-least procedure as the moderate preference. These studies emphasize the necessity of parent-implemented programs, as they are ultimately the ones who will continue to apply these skills regularly, increasing maintenance and generalization of skills. Furthermore, empowering the parent or caregiver by offering technique choices or other relevant options may reduce challenges and may increase the likelihood that they will continue to implement the procedure after the clinician has left the setting or case (Halbur et al., 2020).

Although there are hundreds of applications available on a variety of platforms for phones, tablets, and computers, few studies are evaluating these apps. Presently, there are apps for a wide range of psychological and health-related issues (Préfontaine et al., 2019). For autistic individuals and those with other developmental disabilities, research supports the use of augmentative and alternative communication (AAC) to improve a range of social and communications skills. Research has investigated the effects of several programs including Education App, iPrompts®, Picaa (Aziz et al., 2014), and Proloquo2Go (Collette et al., 2018), which target social skills, the ability to create visual supports, educational activities to promote early learning, and capability for nonvocal learners. Préfontaine et al. (2019) created a parent-implemented app, referred to as the iSTIM (individualized Stereotypy Treatment Integrated Modules), which decreased engagement of stereotypy for 8 of 11 children with ASD. Since these instructional techniques and mobile technologies have the added value of being made accessible to rural communities around the world, where families may be at a disadvantage and unable to acquire services (Subramaniam et al., 2017), additional research is needed to identify the most parent-friendly, effective options.

Telehealth

Providing health-based services remotely via information and communication technologies first began as telemedicine primarily with physicians when face-to-face appointments were not an option due to cost or transportation (Gogia, 2020). Telehealth services go beyond telemedicine in that it provides a wider range of public health and educational services to the community as well as in professional settings, such as administrative and nonclinical meetings, and for distance learning as well as supervision (Gogia, 2020). Although telemedicine initially addressed more extreme situations such as medical emergencies, case consultation for rare conditions, and providing services to areas of limited resources, telehealth has expanded in part due to necessity (i.e., increase in aged individuals living alone, the COVID-19 pandemic) as well as the rapid advances in technologies and easy access to devices (e.g., mobile phones, apps, faster Internet speed). In the last decade, especially during the COVID-19 pandemic, there has been a rise in the literature on telehealth investigating the benefits and complications related to treatment service delivery.

In a 2020 review of 30 studies on the topic of caregiver training via telehealth, researchers determined that of the studies available and conclusions of the publications, there is sufficient evidence of the robust benefits to support telehealth as a service delivery mechanism (Unholz-Bowden et al., 2020). In a distinctive study, Hao et al. (2021) assessed the outcomes of teletherapy compared to traditional face-to-face, parent-mediated interventions for children with ASD. Both groups of parent–child dyads benefited and made similar gains in language skills (i.e., lexical diversity and morphosyntactic complexity). Other researchers have investigated training staff with comparison groups, meaning parent groups who receive one form of training (e.g., online) followed by a second (e.g., remote), but little information is available examining a direct comparison of the two modes of training. Other areas of research specific to remote, parent-supported interventions have focused on social skills (Beaumont et al., 2021), FCT (Lindgren et al., 2020; Simacek et al., 2017; Suess et al., 2014; Wacker et al., 2013a), DTT (Subramaniam et al., 2017), PRT (McGarry et al., 2019), language and communications skills (Vismara et al., 2013), self-care skills (Boutain et al., 2020), and sleep issues for a wide range of individuals including multiple interventions for adolescents (McLay et al., 2020). In addition, there are published articles on imitation skills (Wainer & Ingersoll, 2015), interventions for self-injurious behaviors (Benson et al., 2018), functional analysis (FA) (Wacker et al., 2013b), as well as specific ABA knowledge and skills including instruction delivery, responding to correct reactions and problem behavior, as well as prompting (Fisher et al., 2020). Research has also focused on technician-delivered telehealth services (Neely et al., 2016; Pollard et al., 2021), self-directed online programs, some with coaching or consultation (Ingersoll et al., 2017; Ingersoll & Berger, 2015; Suppo & Mayton, 2014; Vismara et al., 2013), as well as diverse populations including Latinx families (Gevarter et al., 2021), those in LAMI countries (Karr et al., 2017), and children with Rett syndrome (Simacek et al., 2017).

Not only does telehealth have the benefits of reaching individuals who may not have resources or access to services, but it is also highly cost-effective. Several studies have specifically looked at the financial benefits of using telehealth services for individuals with ASD and other neurodevelopmental disabilities. In a study by Lindgren et al. (2016), parents were taught to use an FA and FCT to address their child's behavioral issues. Researchers compared three service delivery methods (i.e., in-home, home telehealth, clinic telehealth) and found that parents in all groups were able to successfully implement the FA and FCT and that children demonstrated a reduction in problem behavior by >90%. Furthermore, both telehealth option costs were significantly less than the in-home program (see Fig. 22.3). Similarly, Wacker et al. (2013b) successfully showed that trained behavior analysts could teach parents to conduct and implement FAs and FCT with positive financial results. In one study, telehealth was used to conduct FAs and was shown to result in financial savings of up to $277 per week, plus this remote service delivery also saved a substantial amount of time since there was no need to commute hours away to rural areas.

Although telehealth is a feasible and accepted service-delivery method for families (Bearss et al., 2018), it is not without limitations. Barriers that can impact telehealth services often include technical issues, specifically video and audio problems with connectivity (e.g., audio delay), and hardware and software issues (e.g., unable to hear) for which Lee et al. (2015) created a decision-making process for troubleshooting these complications along with solutions to remediate the issues. Lerman et al. (2020) also addressed potential barriers and provided strategies for managing other challenges with telehealth services (see Fig. 22.4) including difficulties with using remote viewing during in vivo sessions (e.g., a client engaging in the target behavior behind furniture) and interference in the clients' environment (e.g., unexpected items being accessible when they should not be, or a child trying to grab the device being used for service delivery). Additionally, researchers found

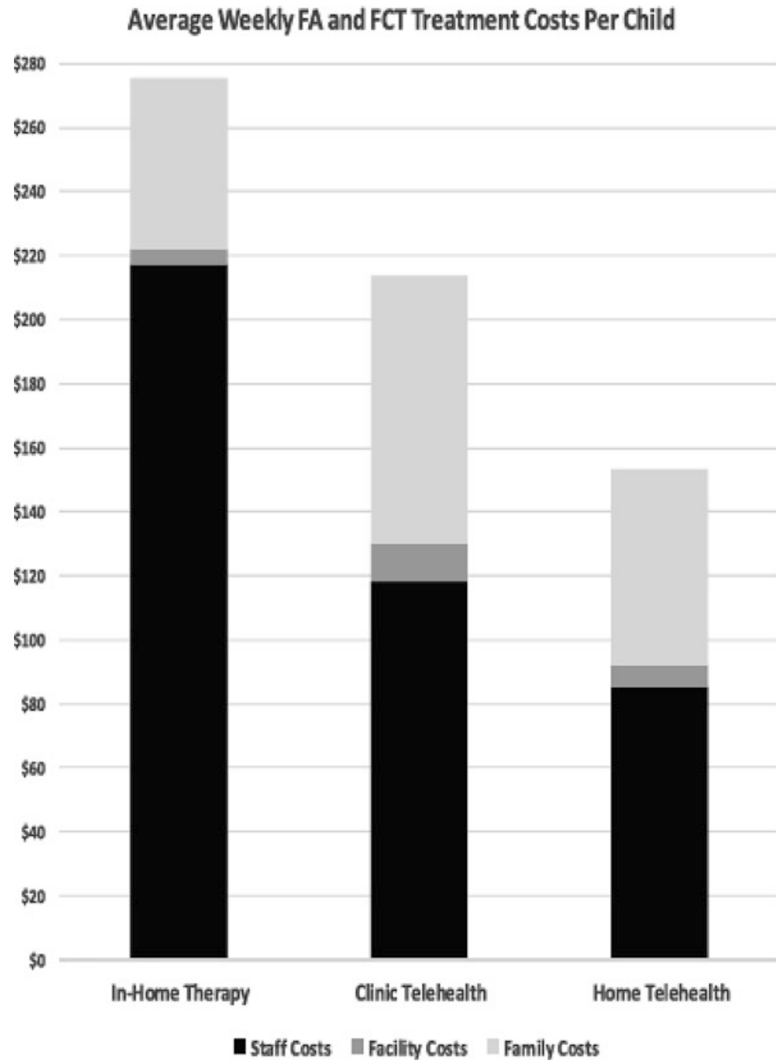


Fig. 22.3 Average weekly FA and FCT treatment costs per child. (From Lindgren et al. (2016))

that difficulties can include less predictable client outcomes such as a dangerous escalation in behavior, unethical situations (e.g., client removing clothing on-screen), and caregivers who are not as responsive to the high levels of verbal stimuli, compared to in-person sessions. Lerman et al. (2020) also created a telehealth checklist published online for professionals to verify if telehealth is an appropriate modality for the client and family.

Overall, despite the growing research in this area, there are still few studies comparing online versus in-person parent-implemented services for a wide range of interventions (Blackman et al., 2020; Hao et al., 2021). Additional research is still needed to examine this topic using more vigorous designs (Boisvert & Hall, 2014), assessing generalization of skills (Gevarter et al., 2021), as well as additional investigations of barriers to treatment fidelity using telehealth and further variations of interventions and procedures (Unholz-Bowden et al., 2020; Vismara et al., 2013; Wacker et al., 2013b). Last, with many of these studies, not all caregivers and children receiving parent-implemented interventions responded the same. Therefore, research must continue to explore if there are specific parental characteristics or other factors, such as a history of services, that may make caregivers less compatible with telehealth alone and that they may

Challenges	Solutions
Technical issues	
Caregiver does not have access to equipment	Establish lending library; locate nearby facility with equipment
Caregiver has connectivity issues	Upgrade modem/Internet service; reduce number of devices
Caregiver has difficulty installing/using software	Provide task analyses; instruct caregiver via phone
Caregiver has hardware or software failures	Provide access to alternative hardware or software
Poor visibility due to room lighting	Close drapes, move away from window, change room lighting
Challenges with remote viewing	
Client not always in view	Modify camera position/session location, remove or rearrange furniture, install physical barriers, use multiple cameras
Client behavior difficult to see or hear	Arrange for caregiver to signal occurrences of target behaviors
Practitioner difficult to see or hear	Arrange for caregiver to wear Bluetooth headset, send text messages
Disruptions in client's environment	
Items present in room disruptive to sessions	Instruct caregiver to remove superfluous items from room
Other family members interrupt sessions	Arrange sessions when other family members not at home
Other issues related to client behavior	
Client engages in dangerous behavior	Mail protective equipment to caregiver, train caregiver to block, prioritize treatments that minimize extinction bursts
Client reactive to practitioner's image or voice	Disconnect audio and/or video feed
Issues related to caregiver behavior	
Caregiver engages in emotional responding	Stop session, speak privately with caregiver
Caregiver behavior insensitive to vocal instructions	Arrange in-person appointments, model procedures on camera, review videotaped sessions with caregiver
Caregiver overly casual in dress or behavior	Clarify expectations at the outset of services
Issues at host site	
Practitioner shares office with others	Use headsets, speak softly, modify appointment schedule
Practitioner not specifically trained for telehealth	Obtain training and supervision from qualified practitioner

Fig. 22.4 Sample of potential challenges and solutions when providing telehealth services. (From Lerman et al. (2020)

require initial in-person sessions to demonstrate the best long-lasting outcomes (Lerman et al., 2020).

Barriers to Parent Training

There is an abundance of limitations and barriers to parent training, as there are for many other psychological and behavior analytic interventions and protocols. Researchers continue to investigate and propose solutions to common barriers such as situational (e.g., location, childcare, scheduling issues), psychological factors (e.g., stigma, apprehensions regarding confidentiality), and lack of awareness of treatment options (Koerting et al., 2013; Smith et al., 2015b). However, what has not been well researched is a behavior analytic assessment of contingencies that affect parent behavior and impact the ability to successfully participate in parent training as well as longitudinal data of correct implementation of skills taught. Two studies have sought to better understand barriers of parent training adherence from a behavior analytic perspective. Allen and Warzak (2000) acknowledged specific behavioral principles and corresponding behaviors that impact caregiver adherence (see Table 22.3), which can be assessed and identified using an FA. Additionally, Stocco and Thompson (2015) noted positive and negative reinforcement contingencies or negative and positive reinforcement traps, which affect parent adherence in PTPs. For instance, when a parent, with or without intention, reinforces child maladaptive behaviors (e.g., gives in and purchases the candy at the store to avoid an escalation of a tantrum) rather than coping with the behavior healthily by teaching and reinforcing improved replacement skills (e.g., asking nicely, accepting "no").

Given the increase in the use of telehealth services but the remaining lack of knowledge on specific parent characteristics that can impact the success of training and treatment fidelity, clinicians can also learn to be more sensitive to their behaviors during the treatment process and how it can directly affect parent behaviors. The therapeutic alliance is imperative for PTPs and individual therapy; therefore, clinicians must be diligent and work hard to be cognizant of their behaviors and modify their actions as needed to support the parent. In an article focused on effective parent consultations, Sanders and Burke (2014) identified common problems that can occur during the phases of the treatment process, impacting parent participation. They created guidelines on how clinicians can modify their assumptions, encourage caregiver development of new skills, and engage in behaviors that may prevent resistance during the treatment process (see Figs. 22.5 and 22.6). These guidelines and recommendations can be used to strengthen the therapeutic alliance, leading to more optimistic treatment outcomes for parents and children.

Table 22.3 Adherence variables

Establishing operations
Failure to establish intermediate outcomes as reinforcers
Failure to disestablish competing social approval as reinforcers
Stimulus generalization
Trained insufficient exemplars
Trained narrow range of setting stimuli
Weak rule following
Response acquisition
Excessive skill complexity
Weak instructional technology
Weak instructional environment
Consequent events
Competing punitive contingencies
Competing reinforcing contingencies

Source: From Allen and Warzak (2000)

Clinicians, therapists, behavior analysts, physicians, and researchers play a vital role in the assessment, diagnosis, and treatment of individuals with autism. Yet they should never underestimate the influence that parents have, not only as agents of change but also as caregivers who can identify initial warning signs, potentially leading to earlier access to services and support. In a recent RCT published by the *Journal of the American Medical Association Pediatrics*, researchers determined that teaching parents of children who exhibit early signs of ASD how to recognize their child's communication cues using video feedback can result in a reduction in ASD symptoms and ASD classification at 3 years of age for infants treated at roughly 9–14 months. Using this preemptive intervention, referred to as the iBASIS-VIPP, a modified version of the Video Interaction for Positive Parenting (VIPP), parents were videotaped engaging with their child in daily routine activities such as play and feeding. Therapists then viewed the videos and taught the parents skills to improve their actions and responses to their child in order to build on the child's social communication development (Whitehouse et al., 2021).

This study reiterates the importance of involving parents in the process of treatment from its earliest stages, ideally before a diagnosis, when only warning signs are present. If this can become the latest version of "care-as-usual" for all children with developmental red flags associated with social communication, then this

Type of problematic practitioner behavior	Parents immediate reaction	Clinical consequence	Alternative practitioner behavior
Practitioner sets difficult or impossible tasks	Parent non complies	Parent drops out	Practitioner negotiates a more achievable set of goals and tasks
Practitioner becomes defensive when challenged	Parent reciprocates with defensiveness	Parent drops out	Practitioner remains non defensive and clarifies the parents referents before responding
Practitioner demonstration of skill is poor	Parent becomes confused and fails to develop necessary skills	Intervention fails	Practitioner demonstrates more appropriate example of the being used correctly
Practitioners explanation of a skill is vague	Parent lacks a clear rationale to support a parenting practice	Parent can't explain what she is doing to significant others	Practitioners provides reviews parenting strategy and develops a more convincing rationale to explain a strategy or skill
Practitioner provides a poor or incorrect response to parents questions	Parent implements a strategy incorrectly	Child does not improve	Practitioner reviews procedure and provides the correct answer to specific question
Practitioner assumes a parent is refusing to try a new skill	Parent becomes angry or defensive; refuses to try the strategy	Parent drops out	Practitioner acknowledges the difficulties associated with making change Practitioner assists parent to anticipate setbacks and other difficulties as a normal part of the change process;
Practitioner fails to recognize that the change effort is hard	Parent becomes disheartened, sees self as a failure	Parent drops out	Practitioner negotiates a more achievable set of goals and tasks
Practitioner rescues an emotional distressed parent	Parent may become dependent	Parent fail to change behavior or become self-regulated	Practitioner acknowledges parental distress through summarization or reflection then refocuses (if appropriate) parents attention to the task at hand
Practitioner provides vague positive feedback	Parent does not improve performance	Parent continues to perform inadequately	Practitioner writes down specific verbatim examples of what the parent did well
Practitioner provides negative judgmental non specific feedback	Parent feel criticized and gets angry	Parent drops out	Practitioner writes down specific examples of what constitutes correct and incorrect implementation of a skill or routine

Fig. 22.5 Common process problems during parent consultation sessions. (From Sanders and Burke (2014))

Practitioner assumptions, beliefs and behaviors	Introducing change	Supporting change	Preventing and managing resistance
Be curious	Client driven goal setting	Collaborative exploration and discussion of presenting problem and potential solutions/strategies	Recognise discomfort/ disengagement in client or practitioner
Assume positive intentions from clients	Offer tentative suggestions	Check goals are realistic	Recognise and attend to any threat to practitioners own values
Acknowledge own values	Provide rationale for suggestions	Acknowledge inherent difficulty of change	Explore client ambivalence to change
Be non-judgemental	Active client involvement	Identify client and contextual factors that support change	Validate client perspective
Be empathic	Matching pace of change to client needs	Identify and problem solve client and contextual factors that impede change	Gently raise issue with client
Demonstrate hope/ optimism	Balancing push for change with support	Build client self regulatory skills	Identify source
View client as expert on their life	Check in (for understanding, agreement and commitment)	Validate client change efforts	Clarify meaning
Be non-defensive	Clarify meaning (client & practitioner)	Encourage self reinforcement	Problem solve solutions
Parents are doing the best they can	Validate client experiences Summarise regularly		Develop goals for moving forward

Fig. 22.6 A guided participation model for promoting change. (From Sanders and Burke (2014))

could narrow the gap of deficits and alter many of these children's developmental trajectories. It could also have substantial benefits not only for parent well-being but also long-term financial reliefs for families and society. However, until then, given the continued worldwide increase in ASD, the mandatory need for interventions, and the astronomical associated costs, parents must continue to play an immense role in their child's treatment. Furthermore, it is the job of those clinicians, behavior analysts, and researchers to ensure that the aforementioned barriers are addressed and that the most efficient and efficacious components of evidence-based interventions are identified and taught. Professionals are also given the responsibility of ensuring that parents are provided with support, compassion, and the guidance they require to be successful to the best of their ability. All children deserve the highest quality of life possible, and by professionals educating, training, and working with parents, those children on the spectrum will have the best chance of receiving that warranted opportunity.

References

Aclan, M. D., & Taylor, R. S. (2017). An evaluation of a caregiver training protocol on the generalization and maintenance of successful pediatric feeding interventions. *Behavioral Interventions, 32*, 182–189. https://doi.org/10.1002/bin.1468

Adams, M. S., Khan, N. Z., Begum, S. A., Wirz, S. L., Hesketh, T., & Pring, T. R. (2011). Feeding difficulties in children with cerebral palsy: Low-cost caregiver training in Dhaka, Bangladesh. *Child: Care, Health and Development, 38*(6), 878–888. https://doi.org/10.1111/j.1365-2214.2011.01327.x

Akemoglu, Y., & Tomeny, K. R. (2021). A parent-implemented shared-reading intervention to promote communication skills of preschoolers with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 51*(8), 2974–2987. https://doi.org/10.1007/s10803-020-04757-0

Alaimo, C., Seiverling, L., Sarubbi, J., & Sturmey, P. (2017). The effects of a behavioral skills training and general-case training package on caregiver implementation of a food selectivity intervention. *Behavioral Interventions, 33*(1), 26–40. https://doi.org/10.1002/bin.1502

Allen, K. D., Vatland, C., Bowen, S. L., & Burke, R. V. (2015). An evaluation of parent-produced video self-modeling to improve independence in an adolescent with intellectual developmental disorder and an autism spectrum disorder: A controlled case study. *Behavior Modification, 39*(4), 542–556. https://doi.org/10.1177/0145445515583247

Allen, K. D., & Warzak, W. J. (2000). The problem of parental nonadherence in clinical behavior analysis: Effective treatment is not enough. *Journal of Applied Behavior Analysis, 33*(3), 373–391. https://doi.org/10.1901/jaba.2000.33-373

Ambitious about Autism. (2021). *Parent toolkit*. https://www.ambitiousaboutautism.org.uk/information-about-autism/early-years/parent-toolkit

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). American Psychiatric Association.

Autism Speaks. (2021). *First concern to action tool kit*. https://www.autismspeaks.org/tool-kit/first-concern-action-tool-kit

Autism Speaks. (n.d.). *Our work*. Retrieved 15 Sept 2021, from https://www.autismspeaks.org/our-work

Aziz, M. Z. A., Abdullah, S. A. C., Adnan, S. F. S., & Mazalan, L. (2014). Educational app for children with autism spectrum disorders (ASDs). *Procedia Computer Science, 42*, 70–77. https://doi.org/10.1016/j.procs.2014.11.035

Bachmeyer-Lee, M. H., Kirkwood, C. A., Sheehan, C. M., Gibson, A. L., Shuler, N. J., & Keane, J. A. (2020). Utilizing in-vivo feedback for caregiver training of pediatric feeding protocols. *Journal of Applied Behavior Analysis, 53*(3), 1622–1637. https://doi.org/10.1002/jaba.693

Bal, V. H., Kim, S., Cheong, D., & Lord, C. (2015). Daily living skills in individuals with autism spectrum disorder from 2 to 21 years of age. *Autism, 19*(7), 774–784. https://doi.org/10.1177/1362361315575840

Bandini, L. G., Curtin, C., Phillips, S., Anderson, S. E., Maslin, M., & Must, A. (2017). Changes in food selectivity in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*(2), 439–446. https://doi.org/10.1007/s10803-016-2963-6

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Barbaro, J., & Freeman, N. C. (2021). Investigating gender differences in the early markers of autism spectrum conditions (ASC) in infants and toddlers. *Research in Autism Spectrum Disorders, 83*(3), 101745. https://doi.org/10.1016/j.rasd.2021.101745

Baumann, A. A., Powell, B. J., Kohl, P. L., Tabak, R. G., Penalba, V., Proctor, E. E., Domenech-Rodriguez, M. M., & Cabassa, L. J. (2015). Cultural adaptation and implementation of evidence-based parent-training: A systematic review and critique of guiding evidence. *Children and Youth Services Review, 53*, 113–120. https://doi.org/10.1016/j.childyouth.2015.03.025

Bearss, K., Burrell, T. L., Challa, S. A., Postorino, V., Gillespie, S. E., Crooks, C., & Scahill, L. (2018). Feasibility of parent training via telehealth for children with autism spectrum disorder and disruptive behavior: A demonstration pilot. *Journal of Autism and Developmental Disorders, 48*(4), 1020–1030. https://doi.org/10.1007/s10803-017-3363-2

Bearss, K., Burrell, T. L., Stewart, L., & Scahill, L. (2015). Parent training in autism spectrum disorder: What's in a name? *Clinical Child and Family Psychology Review, 18*(2), 170–182. https://doi.org/10.1007/s10567-015-0179-5

Beaudoin, A. J., Sébire, G., & Couture, M. (2019). Parent-mediated intervention tends to improve parent-child engagement, and behavioral outcomes of toddlers with ASD-positive screening: A randomized cross-over trial. *Research in Autism Spectrum Disorders, 66*, 101416. https://doi.org/10.1016/j.rasd.2019.101416

Beaumont, R., Walker, H., Weiss, J., & Sofronoff, K. (2021). Randomized controlled trial of a video gaming-based social skills program for children on the autism spectrum. *Journal of Autism and Developmental Disorders, 51*(10), 3637–3650. https://doi.org/10.1007/s10803-020-04801-z

Benson, S. S., Dimian, A. F., Elmquist, M., Simacek, J., McComas, J. J., & Symons, F. J. (2018). Coaching parents to assess and treat self-injurious behaviour via telehealth. *Journal of Intellectual Disability Research, 62*(12), 1114–1123. https://doi.org/10.1111/jir.12456

Bent, S., McDonald, M. G., Chen, Y., Widjaja, F., Wahlberg, J., Hossain, B., & Hendren, R. L. (2021). Brief report: Game day: A novel method of assessing change in social competence in students with autism spectrum disorder (ASD). *Research in Autism Spectrum Disorders, 84*(2), 101766. https://doi.org/10.1016/j.rasd.2021.101766

Blackman, A. L., Jimenez-Gomez, C., & Shvarts, S. (2020). Comparison of the efficacy of online versus in-vivo behavior analytic training for parents of children with autism spectrum disorder. *Behavior Analysis: Research and Practice, 20*(1), 13–23. https://doi.org/10.1037/bar0000163

Boisvert, M., & Hall, N. (2014). The use of telehealth in early autism training for parents: A scoping review. *Smart Homecare Technology and TeleHealth, 2014*(2), 19–27. https://doi.org/10.2147/SHTT.S45353

Booth, N., Gallagher, S., & Keenan, M. (2018). Autism, interventions and parent training. *Psichologija, 57*, 74–94. https://doi.org/10.15388/Psichol.2018.0.11904

Boutain, A. R., Sheldon, J. B., & Sherman, J. A. (2020). Evaluation of a telehealth parent training program in teaching self-care skills to children with autism. *Journal of Applied Behavior Analysis, 53*(3), 1259–1275. https://doi.org/10.1002/jaba.743

Bourchtein, E., Langberg, J. M., & Eadeh, H. (2020). A review of pediatric nonpharmacological sleep interventions: Effects on sleep, secondary outcomes, and populations with co-occurring mental health conditions. *Behavior Therapy, 51*(1), 27–41. https://doi.org/10.1016/j.beth.2019.04.006

Bradshaw, J., Koegel, L. K., & Koegel, R. L. (2017). Improving functional language and social motivation with a parent-mediated intervention for toddlers with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 47*(8), 2443–2458. https://doi.org/10.1007/s10803-017-3155-8

Carr, A. (2019). Family therapy and systemic interventions for child-focused problems: The current evidence base. *Journal of Family Therapy, 41*, 153–213. https://doi.org/10.1111/1467-6427.12226

Carrow, J. N., Vladescu, J. C., Reeve, S. A., & Kisamore, A. N. (2020). Back to sleep: Teaching adults to arrange safe infant sleep environments. *Journal of Applied Behavior Analysis, 53*(3), 1321–1336. https://doi.org/10.1002/jaba.681

Centers for Disease Control and Prevention. (2020a). *Data & statistics on autism spectrum disorder.* https://www.cdc.gov/ncbddd/autism/data.html

Centers for Disease Control and Prevention. (2020b). *Screening and diagnosis of autism spectrum disorder for healthcare providers*. https://www.cdc.gov/ncbddd/autism/hcp-screening.html

Centers for Disease Control and Prevention. (2018). Short sleep duration among middle school and high school students — United States, 2015. *Morbidity and Mortality Report Weekly, 67*(3), 85–90. https://www.cdc.gov/mmwr/volumes/67/wr/mm6703a1.htm?s_cid=mm6703a1_w

Chaffin, M., Funderburk, B., Bard, D., Valle, L. A., & Gurwitch, R. (2011). A combined motivation and parent–child interaction therapy package reduces child welfare recidivism in a randomized dismantling field trial. *Journal of Consulting and Clinical Psychology, 79*(1), 84–95. https://doi.org/10.1037/a0021227

Cohen, J. A., Berliner, L., & Mannarino, A. (2010). Trauma focused CBT for children with co-occurring trauma and behavior problems. *Child Abuse and Neglect, 34*(4), 215–224. https://doi.org/10.1016/j.chiabu.2009.12.003

Collette, D., Brix, A., Brennan, P., DeRoma, N., & Muir, B. C. (2018). Proloquo2Go enhances classroom performance in children with autism spectrum disorder. *OTJR: Occupation, Participation and Health, 39*(3), 143–150. https://doi.org/10.1177/1539449218799451

Cooperative Research Centre for Living with Autism. (2021). *National guideline implementation toolkit now available*. https://www.autismcrc.com.au/news/latest-news/national-guideline-implementation-toolkit-now-available

Crane, D. R. (1995). Introduction to behavioural family therapy for families with young children. *Journal of Family Therapy, 17*, 229–242.

Cruz-Torres, E., Duffy, M. L., Brady, M. P., Bennett, K. D., & Goldstein, P. (2020). Promoting daily living skills for adolescents with autism spectrum disorder via parent delivery of video prompting. *Journal of Autism and Developmental Disorders, 50*(1), 212–223. https://doi.org/10.1007/s10803-019-04215-6

Dababnah, S., & Parish, S. L. (2014). Incredible years program tailored to parents of preschoolers with autism. *Research on Social Work Practice, 26*(4), 372–385. https://doi.org/10.1177/1049731514558004

Davis, S., Thomson, K., & Connolly, M. (2019). A component analysis of behavioral skills training with volunteers teaching motor skills to individuals with developmental disabilities. *Behavioral Interventions, 34*(4), 431–450. https://doi.org/10.1002/bin.1688

Delemere, E., & Dounavi, K. (2018). Parent-implemented bedtime fading and positive routines for children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 48*(4), 1002–1019. https://doi.org/10.1007/s10803-017-3398-4

Dekker, V., Nauta, M. H., Timmerman, M. E., Mulder, E. J., Hoekstra, P. J., & de Bildt, A. (2021). Application of latent class analysis to identify subgroups of children with autism spectrum disorders who benefit from social skills training. *Journal of Autism and Developmental Disorders, 51*(6), 2004–2018. https://doi.org/10.1007/s10803-020-04678-y

Dekker, V., Nauta, M. H., Timmerman, M. E., Mulder, E. J., van der Veen-Mulders, L., van den Hoofdakker, B. J., van Warners, S., Vet, L. J. J., Hoekstra, P. J., & de Bildt, A. (2019). Social skills group training in children with autism spectrum disorder: A randomized controlled trial. *European Child and Adolescent Psychiatry, 28*(3), 415–424. https://doi.org/10.1007/s00787-018-1205-1

Doenyas, C. (2016). The social living complex: A new, all day, yearlong intervention model for individuals with autism spectrum disorder and their parents. *Journal of Autism and Developmental Disorders, 46*(9), 3037–3053. https://doi.org/10.1007/s10803-016-2846-x

Dogan, R. K., King, M. L., Fischetti, A. T., Lake, C. M., Mathews, T. L., & Warzak, W. J. (2017). Parent-implemented behavioral skills training of social skills. *Journal of Applied Behavior Analysis, 50*(4), 805–818. https://doi.org/10.1002/jaba.411

Drifke, M. A., Tiger, J. H., & Wierzba, B. C. (2017). Using behavioral skills training to teach parents to implement three-step prompting: A component analysis and generalization assessment. *Learning and Motivation, 57*, 1–14. https://doi.org/10.1016/j.lmot.2016.12.001

Dubreucq, J., Haesebaert, F., Plasse, J., Dubreucq, M., & Franck, N. (2021). A systematic review and meta-analysis of social skills training for adults with autism spectrum disorder. *Journal of Autism and Developmental Disorders*. https://doi.org/10.1007/s10803-021-05058-w

Eid, A. M., Alhaqbani, O. A., Asfahani, S. M., Alaql, M., AlSaud, A. N., Mohtasib, R. S., Aldhalaan, H. M., & Fryling, M. J. (2017a). Learning by doing and learning by observing: Training parents in Saudi Arabia to implement the natural language paradigm. *Journal of Developmental and Physical Disabilities, 29*, 557–565. https://doi.org/10.1007/s10882-017-9544-2

Eid, A. M., Aljaser, S. M., AlSaud, A. N., Asfahani, S. M., Alhaqbani, O. A., Mohtasib, R. S., Aldhalaan, H. M., & Fryling, M. (2017b). Training parents in Saudi Arabia to implement discrete trial teaching with their children with autism spectrum disorder. *Behavior Analysis in Practice, 10*(4), 402–406. https://doi.org/10.1007/s40617-016-0167-3

eSilva, A. J. M., Barboza, A. A., Miguel, C. F., & da Silva Barros, R. (2019). Evaluating the efficacy of a parent-implemented autism intervention program in northern Brazil. *Trends in Psychology, 27*(2), 523–532. https://doi.org/10.9788/TP2019.2-16

Erturk, B., Hansen, S. G., Machalicek, W., & Kunze, M. (2020). Parent-implemented early social communication intervention for young children with autism spectrum disorder. *Journal of Behavioral Education, 30*, 641–663. https://doi.org/10.1007/s10864-020-09387-1

Feldman, M. A., Azzano, A., Ward, R. A., Hudson, M., Sjaarda, C. P., & Liu, X. (2019). Relationship of family history conditions and early signs of autism spectrum disorder in low and high-risk infants. *Research in Autism Spectrum Disorders, 65*, 25–33. https://doi.org/10.1016/j.rasd.2019.05.002

Field, T. (2017). Infant sleep problems and interventions: A review. *Infant Behavior and Development, 47*, 40–53. https://doi.org/10.1016/j.infbeh.2017.02.002

Fisher, W. W., Luczynski, K. C., Blowers, A. P., Vosters, M. E., Pisman, M. D., Craig, A. R., Hood, S. A., Machado, M. A., Lesser, A. D., & Piazza, C. C. (2020). A randomized clinical trial of a virtual-training program for teaching applied-behavior-analysis skills to parents of children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 53*(4), 1856–1875. https://doi.org/10.1002/jaba.778

Furlong, M., & McGilloway, S. (2015). Barriers and facilitators to implementing evidence-based parenting programs in disadvantaged settings: A qualitative study. *Journal of Child and Family Studies, 24*(6), 1809–1818. https://doi.org/10.1007/s10826-014-9984-6

Galanter, R., Self-Brown, S., Valente, J. R., Dorsey, S., Whitaker, D. J., Bertuglia-Haley, M., & Prieto, M. (2012). Effectiveness of Parent–Child Interaction Therapy delivered to at-risk families in the home setting. *Child and Family Behavior Therapy, 34*(3), 177–196. https://doi.org/10.1080/07317107.2012.707079

Garcia, D., Bagner, D. M., Pruden, S. M., & Nichols-Lopez, K. (2015). Language production in children with and at risk for delay: Mediating role of parenting skills. *Journal of Clinical Child and Adolescent Psychology, 44*(5), 814–825. https://doi.org/10.1080/15374416.2014.900718

Gerencser, K. R., Higbee, T. S., Akers, J. S., & Contreras, B. P. (2017). Evaluation of interactive computerized training to teach parents to implement photographic activity schedules with children with autism spectrum disorder. *Journal of Applied Behavior Analysis, 50*(3), 567–581. https://doi.org/10.1002/jaba.386

Gerow, S., Hagan-Burke, S., Rispoli, M., Gregori, E., Mason, R., & Ninci, J. (2018). A systematic review of parent-implemented functional communication training for children with ASD. *Behavior Modification, 42*(3), 335–363. https://doi.org/10.1177/0145445517740872

Gevarter, C., Najar, A. M., Flake, J., Tapia-Alvidrez, F., & Lucero, A. (2021). Naturalistic communication training for early intervention providers and Latinx parents of children with signs of autism. *Journal of Developmental and Physical Disabilities, 28*, 1–23. https://doi.org/10.1007/s10882-021-09794-w

Gogia, S. (2020). Rationale, history, and basics of telehealth. In S. Gogia (Ed.), *Fundamentals of telemedicine and telehealth* (pp. 11–34). Academic Press. https://doi.org/10.1016/C2017-0-01090-X

Goldman, S. E., Alder, M. L., Burgess, H. J., Corbett, B. A., Hundley, R., Wofford, D., Fawkes, D. B., Wang, L., Laudenslager, M. L., & Malow, B. A. (2017). Characterizing sleep in adolescents and adults with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 47*(6), 1682–1695. https://doi.org/10.1007/s10803-017-3089-1

Halbur, M. E., Kodak, T., Wood, R., & Corrigan, E. (2020). An evaluation of parent preference for prompting procedures. *Journal of Applied Behavior Analysis, 53*(2), 707–726. https://doi.org/10.1002/jaba.616

Hall, W. A., Hutton, E., Brant, R. F., Collet, J. P., Gregg, K., Saunders, R., Ipsiroglu, O., Gafni, A., Triolet, K., Tse, L., Bhagat, R., & Wooldridge, J. (2015). A randomized controlled trial of an intervention for infants' behavioral sleep problems. *BMC Pediatrics, 15*, 181. https://doi.org/10.1186/s12887-015-0492-7

Hamdani, S. U., Akhtar, P., Zill-e-Huma, R., Nazir, H., Minhas, F. A., Sikander, S., Wang, D., Servilli, C., & Rahman, A. (2017). WHO Parents Skills Training (PST) programme for children with developmental disorders and delays delivered by family volunteers in rural Pakistan: Study protocol for effectiveness implementation hybrid cluster randomized controlled trial. *Global Mental Health, 4*, e11. https://doi.org/10.1017/gmh.2017.7

Hao, Y., Franco, J. H., Sundarrajan, M., & Chen, Y. (2021). A pilot study comparing tele-therapy and in-person therapy: Perspectives from parent-mediated intervention for children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 51*(1), 129–143. https://doi.org/10.1007/s10803-020-04439-x

Harriage, B., Blair, K. C., & Miltenberger, R. (2016). An evaluation of a parent implemented in situ pedestrian safety skills intervention for individuals with autism. *Journal of Autism and Developmental Disorders, 46*(6), 2017–2027. https://doi.org/10.1007/s10803-016-2730-8

Hasla, D., Mejia, A., Sanders, M. R., & de Vries, P. J. (2019). Parent programs. In J. M. Rey & A. Martin (Eds.), *JM REY'S IACAPAP e-textbook of child and adolescent mental health*. (A.12 pp. 1–29). International Association for Child and Adolescent Psychiatry and Allied Professions.

Hassan, M., Simpson, A., Danaher, K., Haesen, J., Makela, T., & Thomson, K. (2018). An evaluation of behavioral skills training for teaching caregivers how to support social skill development in their child with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*(6), 1957–1970. https://doi.org/10.1007/s10803-017-3455-z

Hastings, R. P., Robertson, J., & Yasamy, M. T. (2012). Interventions for children with pervasive developmental disorders in low and middle income countries. *Journal of Applied Research in Intellectual Disabilities, 25*(2), 119–134. https://doi.org/10.1111/j.1468-3148.2011.00680.x

Heidlage, J. K., Cunningham, J. E., Kaiser, A. P., Trivette, C. M., Barton, E. E., Frey, J. R., & Roberts, M. Y. (2020). The effects of parent-implemented language interventions on child linguistic outcomes: A meta-analysis. *Early Childhood Research Quarterly, 50*(1), 6–23. https://doi.org/10.1016/j.ecresq.2018.12.006

Hsieh, H., Wilder, D. A., & Abellon, O. E. (2011). The effects of training on caregiver implementation of incidental teaching. *Journal of Applied Behavior Analysis, 44*(1), 199–203. https://doi.org/10.1901/jaba.2011.44-199

Hyman, S. L., Levy, S. E., Myers, S. M., Council on Children's with Disabilities, Section on Developmental and Behavioral Pediatrics, Kuo, D. A., Apkon, S., Davidson, L. F., Ellerbeck, K. A., Foster, J. E. A., Noritz, G. H., Leppert, M. O., Saunders, B. S., Stille, C., Yin, L., Weitzman, C. C., Childers, D. O., Jr., Levine, J. M., Peralta-Caraelen, A. M., Poon, J. K., et al. (2020). Identification, evaluation, and management of children with autism spectrum disorder. *Pediatrics, 145*(1), e20193447. https://doi.org/10.1542/peds.2019-3447

Hunter, J. E., McLay, L. K., France, K. G., & Blampied, N. M. (2020). Systematic review of the collateral effects of behavioral sleep interventions in children and adolescents with autism spectrum disorder. *Research in Autism Spectrum Disorders, 79*, 101677. https://doi.org/10.1016/j.rasd.2020.101677

Ingersoll, B., & Wainer, A. (2013). Initial efficacy of project ImPACT: A parent-mediated social communication intervention for young children with ASD. *Journal of Autism and Developmental Disorders, 43*, 2943–2952. https://doi.org/10.1007/s10803-013-1840-9

Ingersoll, B., & Berger, N. I. (2015). Parent engagement with a telehealth-based parent-mediated intervention program for children with autism spectrum disorders: Predictors of program use and parent outcomes. *Journal of Medical Internet Research, 17*(10), e227. https://doi.org/10.2196/jmir.5329

Ingersoll, B., Shannon, K., Berger, N., Pickard, K., & Holtz, B. (2017). Self-directed telehealth parent-mediated intervention for children with autism spectrum disorder: Examination of the potential reach and utilization in community settings. *Journal of Medical Internet Research, 19*(7), e248. https://doi.org/10.2196/jmir.7484

Johnson, C. R., Brown, K., Hyman, S. L., Brooks, M. M., Aponte, C., Levato, L., Schmidt, B., Evans, V., Huo, Z., Bendixen, R., Eng, H., Sax, T., & Smith, T. (2019). Parent training for feeding problems in children with autism spectrum disorder: Initial randomized trial. *Journal of Pediatric Psychology, 44*(2), 164–175. https://doi.org/10.1093/jpepsy/jsy063

Johnson, C. R., Smith, T., DeMand, A., Lecavalier, L., Evans, V., Gurka, M., Swiezy, N., Bearss, K., & Scahill, L. (2018). Exploring sleep quality of young children with autism spectrum disorder and disruptive behaviors. *Sleep Medicine, 44*, 61–66. https://doi.org/10.1016/j.sleep.2018.01.008

Johnson, C. R., Foldes, E., DeMand, A., & Brooks, M. M. (2015). Behavioral parent training to address feeding problems in children with autism spectrum disorder: A pilot trial. *Journal of Developmental and Physical Disabilities, 27*, 591–607. https://doi.org/10.1007/s10882-015-9437-1

Johnson, C. R., Turner, K. S., Foldes, E., Brooks, M. M., Kronk, R., & Wiggs, L. (2013). Behavioral parent training to address sleep disturbances in young children with autism spectrum disorder: A pilot trial. *Sleep Medicine, 14*(10), 995–1004. https://doi.org/10.1016/j.sleep.2013.05.013

Kadey, H. J., Roane, H. S., Diaz, J. C., & McCathy, C. M. (2013). Using a Nuk® brush to increase acceptance of solids and liquids for two children diagnosed with autism. *Research in Autism Spectrum Disorders, 7*(11), 1461–1480. https://doi.org/10.1016/j.rasd.2013.07.017

Kaehler, L. A., Jacobs, M., & Jones, D. J. (2016). Distilling common history and practice elements to inform dissemination: Hanf-Model BPT programs as an example. *Clinical Child and Family Psychology Review, 19*(3), 236–258. https://doi.org/10.1007/s10567-016-0210-5

Katz, T., & Malow, B. (2014). *Solving sleep problems in children with autism spectrum disorder: A guide for frazzled families*. Woodbine House.

Karr, V., Brusegaard, C., Koly, K. N., van Edema, A., & Naheed, A. (2017). Online parent training: A pilot programme for children with autism and neurodevelopmental disabilities in Bangladesh. *Disability, CBR and Inclusive Development, 29*(3), 56–70. https://doi.org/10.5463/dcid.v28i3.616

Kenny, M. C., Bennett, K. D., Dougery, J., & Steele, F. (2013). Teaching general safety and body safety training skills to a Latino preschool male with autism. *Journal of Child and Family Studies, 22*, 1092–1102. https://doi.org/10.1007/s10826-012-9671-4

Kirkpatrick, B., Louw, J. S., & Leader, G. (2019). Efficacy of parent training incorporated in behavioral sleep interventions for children with autism spectrum disorder and/or intellectual disabilities: A systematic review. *Sleep Medicine, 53*, 141–152. https://doi.org/10.1016/j.sleep.2018.08.034

Koegel, L. K., Koegel, R. L., Ashbaugh, K., & Bradshaw, J. (2014). The importance of early identification and intervention for children with or at risk for autism spectrum disorder. *International Journal of Speech-Language Pathology, 16*(1), 50–56. https://doi.org/10.3109/17549507.2013.861511

Koerting, J., Smith, E., Knowles, M. M., Latter, S., Elsey, H., McCann, D. C., Thompson, M., & Sonuga-Barke, E. J. (2013). Barriers to, and facilitators of, parenting programmes for childhood behaviour problems: A qualitative synthesis of studies of parents' and professionals' perceptions. *European Child and Adolescent Psychiatry, 22*(11), 653–670. https://doi.org/10.1007/s00787-013-0401-2

Ledbetter-Cho, K., Lang, R., Lee, A., Murphy, C., Davenport, K., Kirkpatrick, M., Schollian, M., Moore, M., Billingsley, G., & O'Reilly, M. (2021). Teaching children with autism abduction-prevention skills may result in overgeneralization of the target response. *Behavior Modification, 45*(3), 438–461. https://doi.org/10.1177/0145445519865165

Lee, J. F., Schieltz, K. M., Suess, A. N., Wacker, D. P., Romani, P. W., Lindgren, S. D., Kopelman, T. G., & Dalmau, Y. C. P. (2015). Guidelines for developing telehealth services and troubleshooting problems with telehealth technology when coaching parents to conduct functional analyses and functional communication training in their homes. *Behavior Analysis in Practice, 8*(2), 190–200. https://doi.org/10.1007/s40617-014-0031-2

Lerman, D. C., O'Brien, M. J., Neely, L., Call, N. A., Tsami, L., Schieltz, K. M., Berg, W. K., Graber, J., Huang, P., Kopelman, T., & Cooper-Brown, L. J. (2020). Remote coaching of caregivers via telehealth: Challenges and potential solutions. *Journal of Behavioral Education, 29*, 195–221. https://doi.org/10.1007/s10864-020-09378-2

Lieneman, C. C., Brabson, L. A., Highlander, A., Wallace, N. M., & McNeil, C. B. (2017). Parent–Child Interaction Therapy: Current perspectives. *Psychology Research and Behavior Management, 10*, 239–256. https://doi.org/10.2147/prbm.s91200

Lieneman, C. C., Quetsch, L. B., Theodorou, L. L., Newton, K. A., & McNeil, C. B. (2019). Reconceptualizing attrition in Parent–Child Interaction Therapy: "Dropouts" demonstrate impressive improvements. *Psychology Research and Behavior Management, 12*, 543–555. https://doi.org/10.2147/PRBM.S207370

Lindgren, S., Wacker, D., Schieltz, K., Suess, A., Pelzel, K., Kopelman, T., Lee, J., Romani, P., & O'Brien, M. (2020). A randomized controlled trial of functional communication training via telehealth for young children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 50*(12), 4449–4462. https://doi.org/10.1007/s10803-020-04451-1

Lindgren, S., Wacker, D., Suess, A., Schieltz, K., Pelzel, K., Kopelman, T., Lee, J., Romani, P., & Waldron, D. (2016). Telehealth and autism: Treating challenging behavior at lower cost. *Pediatrics, 137*(Supplement 2), S167–S175. https://doi.org/10.1542/peds.2015-2851O

Loring, W. A., Johnston, R. L., Shui, A. M., & Malow, B. A. (2018). Impact of a brief behavioral intervention for insomnia on daytime behaviors in adolescents with autism spectrum disorders. *Journal of Contemporary Psychotherapy, 48*, 165–177. https://doi.org/10.1007/s10879-018-9381-3

Lukens, C. T., & Silverman, A. H. (2014). Systematic review of psychological interventions for pediatric feeding problems. *Journal of Pediatric Psychology, 39*(8), 903–917. https://doi.org/10.1093/jpepsy/jsu040

Mairena, M. A., Mora-Guiard, J., Malinverni, L., Padillo, V., Valero, L., Hervas, A., & Pares, N. (2019). A full-body interactive videogame used as a tool to foster social initiation conducts in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 67*, 101438. https://doi.org/10.1016/j.rasd.2019.101438

Malow, B. A., Adkins, K. W., Reynolds, A., Weiss, S. K., Loh, A., Fawkes, D., Katz, T., Goldman, S. E., Madduri, N., Hundley, R., & Clemons, T. (2014). Parent-based sleep education for children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*(1), 216–228. https://doi.org/10.1007/s10803-013-1866-z

Mandelberg, J., Frankel, F., Cunningham, T., Gorospe, C., & Laugeson, E. A. (2014). Long-term outcomes of parent-assisted social skills intervention for high-functioning children with autism spectrum disorders. *Autism, 18*(3), 255–263. https://doi.org/10.1177/1362361312472403

Matson, J. L., Hattier, M. A., & Belva, B. (2012a). Treating adaptive living skills of persons with autism using applied behavior analysis: A review. *Research in Autism Spectrum Disorders, 6*(1), 271–276. https://doi.org/10.1016/j.rasd.2011.05.008

Matson, J. L., Turygin, N. C., Beighley, J., Rieske, R., Tureck, K., & Matson, M. L. (2012b). Applied behavior analysis in autism spectrum disorders: Recent developments, strengths, and pitfalls. *Research in Autism Spectrum Disorders, 6*(1), 144–150. https://doi.org/10.1016/j.rasd.2011.03.014

Marlow, M., Servili, C., & Tomlinson, M. (2019). A review of screening tools for the identification of autism spectrum disorders and developmental delay in infants and young children: Recommendations for use in low- and middle-income countries. *Autism Research, 12*(2), 176–199. https://doi.org/10.1002/aur.2033

Mazurek, M. O., & Sohl, K. (2016). Sleep and behavioral problems in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 46*(6), 1906–1915. https://doi.org/10.1007/s10803-016-2723-7

MacDonald, L. L., Gray, L., Loring, W., Wyatt, A., Bonnet, K., Schlund, D., Gaston, M. L., & Malow, B. A. (2021). A community-based sleep educational intervention for children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 81*, 101719. https://doi.org/10.1016/j.rasd.2020.101719

McGarry, E., Vernon, T., & Baktha, A. (2019). Brief report: A pilot online pivotal response treatment training program for parents of toddlers with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 50*(9), 3424–3431. https://doi.org/10.1007/s10803-019-04100-2

McLay, L. K., France, K. G., Knight, J., Blampied, N. M., & Hastie, B. (2018). The effectiveness of function-based interventions to treat sleep problems, including unwanted co-sleeping, in children with autism. *Behavioral Interventions, 34*(1), 30–51. https://doi.org/10.1002/bin.1651

McLay, L., Sutherland, D., Machalicek, W., & Sigafoos, J. (2020). Systematic review of telehealth interventions for the treatment of sleep problems in children and adolescents. *Journal of Behavioral Education, 29*(2), 222–245. https://doi.org/10.1007/s10864-020-09364-8

Madzharova, M. S., & Sturmey, P. (2015). Effects of video modeling and feedback on mothers' implementation of peer-to-peer manding. *Behavioral Interventions, 30*(3), 270–285. https://doi.org/10.1002/bin.1414

Morawska, A., Sanders, M., Goadby, E., Headley, C., Hodge, L., McAuliffe, C., Pope, S., & Anderson, E. (2011). Is the Triple P-Positive Parenting Program acceptable to parents from culturally diverse backgrounds? *Journal of Child and Family Studies, 20*, 614–622. https://doi.org/10.1007/s10826-010-9436-x

Mozolic-Staunton, B., Donelly, M., Yoxall, J., & Barbaro, J. (2020). Early detection for better outcomes: Universal developmental surveillance for autism across health and early childhood education settings. *Research in Autism Spectrum Disorders, 71*, 101496. https://doi.org/10.1016/j.rasd.2019.101496

Murphy, J., Zlomke, K., VanOrmer, J., & Swingle, H. (2020). Impact of disruptive behavior in childhood feeding difficulties. *Journal of Clinical Psychology in Medical Settings, 27*, 406–415. https://doi.org/10.1007/s10880-019-09646-y

Najdowski, A. C., Wallace, M. D., Reagon, K., Penrod, B., Higbee, T. S., & Tarbox, J. (2010). Utilizing a home-based parent training approach in the treatment of food selectivity. *Behavioral Interventions, 25*(2), 89–107. https://doi.org/10.1002/bin.298

Neely, L., Rispoli, M., Gerow, S., & Hong, E. R. (2016). Preparing interventionists via telepractice in incidental teaching for children with autism. *Journal of Behavior Education, 25*, 393–416. https://doi.org/10.1007/s10864-016-9250-7

Ong, S. Y., Roslan, S., Ahmad, N. A., Ayub, A. F. M., Ping, C. L., Zaremohzzabieh, Z., & Ahrari, S. (2021). A mixed-methods evaluation of parent-assisted children's friendship training to improve social skills and friendship quality in children with autism in Malaysia. *International Journal of Environmental Research and Public Health, 18*(5), 2566. https://doi.org/10.3390/ijerph18052566

Pacia, C., Holloway, J., Gunning, C., & Lee, H. (2021). A systematic review of family-mediated social communication interventions for young children with autism. *Review Journal of Autism and Developmental Disorders, 1*, 1–27. https://doi.org/10.1007/s40489-021-00249-8

Patterson, G. R. (1982). *Coercive family process*. Castalia Publishing Co.

Pangborn, M. M., Borrero, C. S., & Borrero, J. C. (2013). Sequential application of caregiver training to implement pediatric feeding protocols. *Behavioral Interventions, 28*(2), 107–130. https://doi.org/10.1002/bin.1356

Pidano, A. E., & Allen, A. R. (2015). The incredible years series: A review of the independent research base.

Journal of Child and Family Studies, 24, 1898–1916. https://doi.org/10.1007/s10826-014-9991-7

Pisman, M. D., & Luczynski, K. C. (2020). Caregivers can implement play-based instruction without disrupting child preference. *Journal of Applied Behavior Analysis, 53*(3), 1702–1775. https://doi.org/10.1002/jaba.705

Pollard, J. S., LeBlanc, L. A., Griffin, C. A., & Baker, J. M. (2021). The effects of transition to technician-delivered telehealth ABA treatment during the COVID-19 crisis: A preliminary analysis. *Journal of Applied Behavior Analysis, 54*(1), 87–102. https://doi.org/10.1002/jaba.803

Préfontaine, I., Lanovaz, M. J., McDuff, E., McHugh, C., & Cook, J. K. (2019). Using mobile technology to reduce engagement in stereotypy: A validation of decision-making algorithms. *Behavior Modification, 43*(2), 222–245. https://doi.org/10.1177/0145445517748560

Puffer, E. S., Green, E. P., Chase, R. M., Sim, A. L., Zayzay, J., Friis, E., Garcia-Rolland, E., & Boone, L. (2015). Parents make the difference: A randomized-controlled trial of a parenting intervention in Liberia. *Global Mental Health, 2*(e15). https://doi.org/10.1017/gmh.2015.12

Radley, K. C., O'Handley, R. D., Ness, E. J., Ford, W. B., Battaglia, A. A., McHugh, M. B., & McLemore, C. E. (2014). Promoting social skill use and generalization in children with autism spectrum disorder. *Research in Autism Spectrum Disorders, 8*(6), 669–680. https://doi.org/10.1016/j.rasd.2014.03.012

Ratcliffe, B., Wong, M., Dossetor, D., & Hayes, S. (2014). Teaching social-emotional skills to school-age children with autism spectrum disorder: A treatment versus control trial in 41 mainstream schools. *Research in Autism Spectrum Disorders, 8*(12), 1722–1733. https://doi.org/10.1016/j.rasd.2014.09.010

Raulston, T., Bhana, N., McIntyre, L. L., & Ousley, C. (2021). Brief report: Collateral joint engagement during a playdate intervention for children with and at risk for autism. *Journal of Autism and Developmental Disorders, 51*(1), 357–363. https://doi.org/10.1007/s10803-020-04544-x

Reitzel, J., Summers, J., Lorv, B., Szatmari, P., Zwaigenbaum, L., Georgiades, S., & Duku, E. (2013). Pilot randomized controlled trial of a functional behavior skills training program for young children with autism spectrum disorder who have significant early learning skill impairments and their families. *Research in Autism Spectrum Disorders, 7*(11), 1418–1432. https://doi.org/10.1016/j.rasd.2013.07.025

Roberts, C. A., Smith, K. C., & Sherman, A. K. (2019). Comparison of online and face-to-face parent education for children with autism and sleep problems. *Journal of Autism and Developmental Disorders, 49*(4), 1410–1422. https://doi.org/10.1007/s10803-018-3832-2

Ros, R., Hernandez, J., Graziano, P. A., & Bagner, D. M. (2016). Parent training for children with or at risk for developmental delay: The role of parental homework completion. *Behavior Therapy, 47*(1), 1–13. https://doi.org/10.1016/j.beth.2015.08.004

Sacrey, L. R., Zwaigenbaum, L., Bryson, S., Brian, J., Smith, I. M., Roberts, W., Szatmari, P., Vaillancourt, T., Roncadin, C., & Garon, N. (2021). Screening for behavioral signs of autism spectrum disorder in 9-month-old infant siblings. *Journal of Autism and Developmental Disorders, 51*(3), 839–848. https://doi.org/10.1007/s10803-020-04371-0

Sanders, M. R., & Burke, K. (2014). The "hidden" technology of effective parent consultation: A guided participation model for promoting change in families. *Journal of Child and Family Studies, 23*(7), 1289–1297. https://doi.org/10.1007/s10826-013-9827-x

Sanberg, S. A., Kuhn, B. R., & Kennedy, A. E. (2018). Outcomes of a behavioral intervention for sleep disturbances in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 48*(12), 4250–4277. https://doi.org/10.1007/s10803-018-3644-4

Sengupta, K., Mahadik, S., & Kappor, G. (2020). Globalizing project ImPACT: Feasibility, acceptability and preliminary outcomes of a parent-mediated social communication intervention for autism adapted to the Indian context. *Research in Autism Spectrum Disorders, 76*(1), 101585. https://doi.org/10.1016/j.rasd.2020.101585

Schultz, T. R., Schmidt, C. T., & Stichter, J. P. (2011). A review of parent education programs for parents of children with autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 26*(2), 94–104. https://doi.org/10.1177/1088357610397346

Seiverling, L., Williams, K., Sturmey, P., & Hart, S. (2012). Effects of behavioral skills training on parental treatment of children's food selectivity. *Journal of Applied Behavior Analysis, 45*(1), 197–203. https://doi.org/10.1901/jaba.2012.45-197

Simacek, J., Dimian, A. F., & McComas, J. J. (2017). Communication intervention for young children with severe neurodevelopmental disabilities via telehealth. *Journal of Autism and Developmental Disorders, 47*(93), 744–767. https://doi.org/10.1007/s10803-016-3006-z

Sirin, N., & Tekin-Iftar, E. (2016). Opinions of Turkish parents and teachers about safety skills instruction to children with autism spectrum disorders: A preliminary investigation. *Journal of Autism and Developmental Disorders, 46*(8), 2653–2665. https://doi.org/10.1007/s10803-016-2809-2

Sharp, W. G., Burrell, T. L., & Jaquess, D. L. (2014). The autism MEAL plan: A parent-training curriculum to manage eating aversions and low intake among children with autism. *Autism, 18*(6), 712–722. https://doi.org/10.1177/1362361313489190

Shire, S. Y., Goods, K., Shih, W., Distefano, C., Kaiser, A., Wright, C., Mathy, P., Landa, R., & Kasari, C. (2015). Parents' adoption of social communication intervention strategies: Families including children with autism spectrum disorder who are minimally verbal. *Journal of Autism and Developmental Disorders, 45*, 1712–1724. https://doi.org/10.1007/s10803-014-2329-x

Shum, K. K., Cho, W. K., Lam, L. M. O., Laugeson, E. A., Wong, W. S., & Law, L. S. K. (2019). Learning how to make friends for Chinese adolescents with autism spectrum disorder: A randomized controlled trial of the Hong Kong Chinese version of the PEERS® intervention. *Journal of Autism and Developmental Disorders, 49*(2), 527–5411. https://doi.org/10.1007/s10803-018-3728-1

Skinner, B. F. (1953). *Science and human behavior*. Free Press.

Smith, I. M., Flanagan, H. E., Garon, N., & Bryson, S. E. (2015a). Effectiveness of community-based early intervention based on pivotal response treatment. *Journal of Autism and Developmental Disorders, 45*(6), 1858–1872. https://doi.org/10.1007/s10803-014-2345-x

Smith, E., Koerting, J., Latter, S., Knowles, M. M., McCann, D. C., Thompson, M., & Sonuga-Barke, E. J. (2015b). Overcoming barriers to effective early parenting interventions for attention-deficit hyperactivity disorder (ADHD): Parent and practitioner views. *Child: Care, Health and Development, 41*(1), 93–102. https://doi.org/10.1111/cch.12146

Stocco, C. S., & Thompson, R. H. (2015). Contingency analysis of caregiver behavior: Implications for parent training and future directions. *Journal of Applied Behavior Analysis, 48*(2), 417–435. https://doi.org/10.1002/jaba.206

Subramaniam, S., Brunson, L. Y., Cook, J. E., Larson, N. A., Poe, S. G., & St. Peter, C. C. (2017). Maintenance of parent-implemented discrete-trial instruction during videoconferencing. *Journal of Behavioral Education, 26*, 1–26. https://doi.org/10.1007/s10864-016-9258-z

Suess, A. N., Romani, P. W., Wacker, D. P., Dyson, S. M., Kuhle, J. L., Lee, J. F., Lindgren, S. D., Kopelman, T. G., Pelzel, K. E., & Waldron, D. B. (2014). Evaluating the treatment fidelity of parents who conduct in-home functional communication training with coaching via telehealth. *Journal of Behavioral Education, 23*(1), 34–59. https://doi.org/10.1007/s10864-013-9183-3

Summers, J., Tarbox, J., Findel-Pyles, R. S., Wilke, A. E., Bergstrom, R., & Williams, W. L. (2011). Teaching two household safety skills to children with autism. *Research in Autism Spectrum Disorders, 5*(1), 629–632. https://doi.org/10.1016/j.rasd.2010.07.008

Suppo, J. L., & Mayton, M. R. (2014). Expanding training opportunities for parents of children with autism. *Rural Special Education Quarterly, 33*(3), 19–28. https://doi.org/10.1177/875687051403300304

Unholz-Bowden, E., McComas, J. J., McMaster, K. L., Girtler, S. N., Kolb, R. L., & Shipchandler, A. (2020). Caregiver training via telehealth on behavioral procedures: A systematic review. *Journal of Behavioral Education, 29*, 246–281. https://doi.org/10.1007/s10864-020-09381-7

Valeri, G., Casula, L., Menghini, D., Amendola, F. A., Napoli, E., Pasqualetti, P., & Vicari, S. (2020). Cooperative parent-mediated therapy for Italian preschool children with autism spectrum disorder: A randomized controlled trial. *European Child and Adolescent Psychiatry, 29*, 935–946. https://doi.org/10.1007/s00787-019-01395-5

Vismara, L. A., McCormick, C., Young, G. S., Nadhan, A., & Monlux, K. (2013). Preliminary findings of a telehealth approach to parent training in autism. *Journal of Autism and Developmental Disorders, 43*(12), 2953–2969. https://doi.org/10.1007/s10803-013-1841-8

Voulgarakis, H., Forte, S., Giacomelli, C., Bendell-Estroff, D., & Krous, H. (2017). Effects of antecedent manipulations and social reinforcement to increase lateral positioning in a premature infant with obstructive sleep apnea. *Behavior Analysis in Practice, 10*(1), 83–86. https://doi.org/10.1007/s40617-016-0141-0

Vriend, J. L., Corkum, P. V., Moon, E. C., & Smith, I. M. (2011). Behavioral interventions for sleep problems in children with autism spectrum disorders: Current findings and future directions. *Journal of Pediatric Psychology, 36*(9), 1017–1029. https://doi.org/10.1093/jpepsy/jsr044

Wacker, D. P., Lee, J. F., Dalmau, Y. C. P., Kopelman, T. G., Lindgren, S. D., Kuhle, J., Pelzel, K. E., Dyson, S., Schieltz, K. M., & Waldron, D. B. (2013a). Conducting functional communication training via telehealth to reduce the problem behavior of young children with autism. *Journal of Developmental and Physical Disabilities, 25*(1), 35–48. https://doi.org/10.1007/s10882-012-9314-0

Wacker, D. P., Lee, J. F., Dalmau, Y. C. P., Kopelman, T. G., Lindgren, S. D., Kuhle, J., Pelzel, K. E., & Waldron, D. B. (2013b). Conducting functional analyses of problem behavior via telehealth. *Journal of Applied Behavior Analysis, 46*(1), 31–46. https://doi.org/10.1002/jaba.29

Wainer, A. L., & Ingersoll, B. R. (2015). Increasing access to an ASD imitation intervention via a telehealth parent training program. *Journal of Autism and Developmental Disorders, 45*(12), 3877–3890. https://doi.org/10.1007/s10803-014-2186-7

Ward-Horner, J., & Sturmey, P. (2012). Component analysis of behavior skills training in functional analysis. *Behavioral Interventions, 27*(2), 75–92. https://doi.org/10.1002/bin.1339

Whitehouse, A. J. O., Varcin, K. J., Pillar, S., Billingham, W., Alvares, G. A., Barbaro, J., Bent, C. A., Blenkley, D., Boutrus, M., Chee, A., Chetcuti, L., Clark, A., Davidson, E., Dimov, S., Dissanayake, C., Doyle, J., Grant, M., Green, C. C., Harrap, M., et al. (2021). Effect of preemptive intervention on developmental outcomes among infants showing early signs of autism: A randomized clinical trial of outcomes to diagnosis. *JAMA Pediatrics, 11*(e213298). https://doi.org/10.1001/jamapediatrics.2021.3298

Yakubova, G., & Chen, B. B. (2021). Examining the effects of parent-created and parent-implemented video prompting to teach daily living skills to an adolescent with autism. *Journal of Autism and Developmental Disorders, 51*(12), 4679–4691. https://doi.org/10.1007/s10803-021-04913-0

Taylor, S., Purdy, S., Jackson, B., Phillips, K., & Virues-Ortega, J. (2019). Evaluation of a home-based behavioral treatment model for children with tube dependency. *Journal of Pediatric Psychology, 44*(6), 656–668.

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