Applied Behavior Analysis and Related Treatments

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A strong body of evidence demonstrates that the most effective interventions for individuals with autism spectrum disorder (ASD) are those derived from applied behavior analysis (ABA), an empirically validated and effective treatment rooted in well-established behavioral principles (Foxx, 2008). In an initial review of 775 peer-reviewed research studies, the National Autism Center's National Standards Project (NSP) found that, of the treatments found to be effective for individuals with ASD, "the overwhelming majority" were behavioral approaches, including ABA (National Autism Center, 2009). The NSP review established that "treatments from the behavioral literature have the strongest research support at this time" (p. 52). ABA-based therapy was endorsed as the treatment of choice by the United States Surgeon General (General, U.S., 1999) and has been recognized by many professional and research organizations, including the American Academy of Pediatrics (Maglione, Gans, Das, Timbie, & Kasari, 2012), the American Psychological Association (Autism Treatment Options, 2017; Kazdin, 2000), and the National Institute of Mental Health (NIMH, 2007). Furthermore, early interventions for children with ASD that have a primary emphasis in alternative approaches, such as facilitated communication and auditory integration training, have been found to be ineffective among this population (Foxx, 2008).

As the evidence supporting ABA-based therapy has mounted over the last decades, the demand for ABA-based therapy by parents has resulted in systemic changes. Access to ABA-based therapy for individuals with ASD varies by location but is now accessible to individuals and families privately at home, in public and private schools, at ABA centers, and through community mental health facilities. Many states now require insurance providers to cover behavior therapy (including ABA) for individuals with ASD (Autism and Insurance Coverage, 2015), and some states have provisions to make Medicaid funds available for behavioral therapy (L & M Policy Research, 2014). Given a strong body of evidence and growing support across numerous professional health institutions and organizations, ABA should be considered the first-line intervention for developing a broad array of skills and reducing aberrant behaviors among children with ASD.

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This chapter will briefly describe ABA-based interventions for children with ASD. ABA does not refer to a single treatment program but rather an empirically based behavioral technology. There are many ABA-based stand-alone interventions in addition to treatment packages or programs that incorporate multiple stand-alone interventions. This chapter serves as an introduction to both key stand-alone strategies and broader treatment packages. This chapter is not meant to serve as a primer or manual to begin implementing ABA or ABA-based interventions but rather as a reference for parents, teachers, and other providers to identify appropriate services for individuals with ASD.

Applied Behavior Analysis (ABA) Defined

Broadly, ABA refers to the use of basic behavior change principles to change behavior that is important and socially relevant (Miltenberger, 2012). Whereas basic behavioral research examines the environmental variables that impact the behavior of animals and humans in laboratory settings, ABA represents the direct application of those basic laboratory discoveries to change the behavior of people in important and meaningful ways.

Components or strategies of ABA are used in everyday life to teach, improve, or increase socially desirable behavior and to decrease undesirable behavior. B. F. Skinner, one of the first scientists credited with the identification of the principles of behavior change, pioneered basic behavior research (Moore, 2008). The field of behavioral sciences has, in turn, informed the direct application of ABA across the realms of mental illness; education and special education; rehabilitation; community psychology; clinical psychology; business, industry, and human services; self-management; child behavior management; prevention; sports performance; health-related behaviors; and gerontology (Miltenberger, 2012).

The core principles of behavior analysis and ABA state that by examining and changing elements of an environment, behavior changes correspondingly. Events and variables surrounding a behavior are examined to identify what is causing behavior or, conversely, keeping a behavior from occurring. The behavior (B), its antecedents (A), and consequences (C), are collectively referred to as a three-term or ABC contingency (Pence, Roscoe, Bourret, & Ahearn, 2009). For example, when the consequence or outcome of a behavior is good or pleasurable, that behavior is likely to be repeated. When the consequence increases the likelihood of a behavior occurring again, the behavior has been reinforced. Conversely, when the consequence decreases the likelihood of a behavior occurring again, the behavior has been punished. This paradigm can be applied to a wide range of target goals and/or problem behaviors and is in turn a compelling treatment approach among children with ASD, a disorder with high levels of heterogeneity (Hu & Steinberg, 2009).

Stand-Alone ABA-Based Interventions

There are many specific intervention strategies derived from principles of ABA. These techniques harness the basic components of behavior modification and can be categorized into three groups depending on where they fall in the ABC model: antecedent, behavioral/instructional, and consequence strategies (Boutout & Hume, 2012). These strategies are supported by research demonstrating a wide range of positive outcomes. Although the strategies can help change the behavior of any person, the strategies described below have been found to be particularly useful for children with ASD.

Antecedent Strategies

Antecedent strategies include interventions that take place before any behavior occurs. Specifically, these strategies target changes to the environment that help decrease or increase the likelihood that a behavior will occur.

Behavioral Momentum Behavioral momentum (Nevin, Mandell, & Atak, 1983) is an antecedent intervention that increases the likelihood of a behavior. When behavioral momentum is applied, the child is first told to do several low-effort tasks (e.g., "touch your nose"; "close your eyes") before he is told to do something that he is less likely to do (e.g., "stand up"). It is key that those initial requests are high-probability requests, as behavioral momentum depends on compliance with these commands in the sequence. It is also important that a compliant response to each command be followed by a reinforcer. Research has demonstrated that behavioral momentum can help increase compliance to a variety of directions (e.g., come here, stand up, put your book away, get your shoes, etc.) as well as the time it takes to start and complete a task (e.g., Belfiore, Basile, & Lee, 2008; Mace et al., 1988; Romano & Roll, 2000). Behavioral momentum is supported by research in both home and school settings.

Choice Incorporating choice into routines and behavioral and academic interventions has been demonstrated to have positive effects for children with disabilities, including ASD. Choosing which activity to complete has been shown to increase academic engagement and reduce disruptive behaviors, such as noncompliance and property destruction (e.g., Dunlap et al., 1994) and other severe problem behaviors such as aggression, elopement, and self-injurious behavior in children with severe ASD (Dyer, Dunlap, & Winterling, 1990). Providing students choices within activities, such as where to work or which materials to use, may also increase engagement and decrease disruptive behavior (e.g., Rispoli et al., 2013). For example, in a study by Lough, Rice, and Lough (2012), offering choice was also found to increase the amount of time spent in an activity. Some studies have found that choice may influence rate of skill acquisition and accuracy of responding when students are allowed to choose which reinforcer they receive, although other studies have not found this effect (e.g., Elliott & Dillenburger, 2016; Newman, Needelman, Reinecke, & Robek, 2002; Toussaint, Kodak, & Vladescu, 2015).

Environmental Modifications Careful consideration and modification to a person's environment can have an impact on his or her behavior. Environmental changes may include changes to the physical, social, and programmatic aspects of the environment (e.g., Davis & Fox, 1999; Nordquist & Twardosz, 1990). Although results from research have been mixed and more information is needed regarding the effects of different environmental modifications, there is some evidence to the impact of these interventions on behavior. For example, Rosenfield, Lambert, and Black (1985) found that students were found to have more on-task behavior and less off-task behavior and withdrawal when seated at desks that were arranged in circles compared to clusters and rows. Social interactions during play may be higher when the same number of children is in a small compared to a larger play area (e.g., Brown, Fox, & Brady, 1987). Careful playground design has been shown to increase the rate of group play and social interactions in children with ASD (e.g., Yuill, Strieth, Roake, Aspden, & Todd, 2007). Types of seating, such as therapy balls (e.g., Schilling & Schwartz, 2004), may increase academic engagement compared to typical classroom chairs in some children with ASD.

Errorless Learning Errorless learning (Terrace, 1963) is a method of teaching that is designed to increase accurate responding and decrease inaccurate responding. Tasks are initially manipulated in such ways that the responder is highly likely to provide a correct response and support is later faded and the task becomes more difficult. Errorless learning has been used to help individuals more easily and quickly learn to identify sight words (e.g., Walsh & Lamberts, 1979), colors (e.g., Powers, Cheney, & Agostino, 1970), and letters (e.g., Egeland, 1975) from an array of options. Stimulus fading, in which the correct behavior or response is initially made clear (such as by highlighting the

correct answer), is a common instructional strategy that utilizes an errorless approach. Errorless approaches have also been utilized to increase the rate of compliance in children with ASD (e.g., Ducharme & Ng, 2012; Rames-LaPointe, Hixson, Niec, & Rhymer, 2014). For example, Ducharme and Ng (2012) found that the proportion of compliant responses increased up to 88% points after treatment.

Individual Interest Individuals with ASD sometimes exhibit intense interests in certain topics, activities, materials, or toys. Although these restricted interests can be problematic and interventions often seek to reduce or eliminate restricted interests, they can also be effectively incorporated into interventions for children with ASD. In a large review of existing research, Gunn and Delafield-Butt (2016) found that including restricted interests in teaching and learning routines resulted in beneficial outcomes in "learning, communication, social engagement, or behavior or emotional well-being" (p. 416). There are many simple ways in which restricted interests can be incorporated into routines and interventions, such as providing books about restricted topics of interest (e.g., Mancil & Pearl, 2008) and arranging social interactions with peers that involve restricted interests. Although the benefits of including restricted interests generally outweigh any negative results, incorporating restricted interests has resulted in relatively minor unwanted outcomes, such as an increase in perseverative and inappropriate behaviors (Gunn & Delafield-Butt, 2016).

Priming Priming is a method of preparation that includes previewing expected behavior (Boutout & Hume, 2012). This may include modeling, practicing, or rehearsing the target behavior or simply reviewing the next day's schedule. Priming is intended to increase the likelihood of success in a variety of tasks or activities and has been demonstrated to be beneficial for individuals with ASD. For example, one method of priming that has been utilized for students with ASD is previewing academic activities. Such priming sessions may include familiarizing students with the materials that will be used in an activity, previewing the schedule or order of events in an activity, or preparing the student for the skills that will be taught. Academic priming has been utilized for children with ASD and found to increase academic responding and engagement and decrease problem behavior (e.g., Koegel, Koegel, Frea, & Green-Hopkins, 2003). Another method of priming is to observe other individuals successfully completing a target activity. For example, video modeling has been successfully utilized to increase independent toileting skills (e.g., Bainbridge & Myles, 1999; McLay, Carnett, van der Meer, & Lang, 2015), peer interaction and play skills (e.g., Sancho, Sidener, Reeve, & Sidener, 2010), and transitioning (Schreibman, Whalen, & Stahmer, 2000).

Time Delay Time delay is used to teach correct responding in a variety of situations. The time delay procedure includes presenting an instruction (e.g., flashcard, verbal prompt) and immediately providing the correct response (Boutout & Hume, 2012). Eventually, after the individual has successfully repeated the correct response, the time between the instruction and giving the correct response is increased. Time delay has been shown to help teach individuals with ASD academic skills such as identifying sight words (e.g., Browder, Ahlgrim-Delzell, Spooner, Mims, & Baker, 2009; Swain, Lane, & Gast, 2015), communication skills (e.g., Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010; Leung, 1994) and social skills (e.g., Liber, Frea, & Symon, 2008), and even swimming skills (e.g., Rogers, Hemmeter, & Wolery, 2010). In one study, Akmanoglu, Kurt, and Kapan (2015) used a time delay procedure to teach children with ASD how to respond to questions about personal information (e.g., "What grade are you in?"; "How old are you?").

Visual Supports Visual supports are a widely used strategy for assisting individuals with ASD

that generally consist of visual representations of information. Visual supports are generally thought to help compensate for verbal language and communication deficits that are core deficits inherent with a diagnosis of ASD (e.g., Hodgdon, 1995). Visuals may depict the day's schedule or routine, available activities such as during break or leisure times, step-by-step task instructions, rules, and behavioral expectations. Social stories are another type of visual support that uses pictures and images to depict more complex behaviors or expectations. For example, social stories were found to be effective in helping students engage in appropriate group-time behaviors and social behaviors (e.g., Crozier & Tincani, 2007), to increase compliance with transitions (e.g., Dettmer, Simpson, Myles, & Ganz, 2000; Dooley, Wilczenski, & Torem, 2001), decrease aggression (e.g., Dooley et al., 2001), and decrease the number of verbal or physical prompts (e.g., Dettmer et al., 2000).

Instructional and Behavioral Strategies

Instructional or behavioral interventions are utilized to create or strengthen new skills. Many of these strategies have been developed for and utilized with children with ASD.

Chaining Chaining involves breaking a complex task down into relatively easy or short components. For example, tying shoes can be broken down into segments beginning with crossing the laces and ending with tightening the loops (e.g., Rayner, 2011). Each component is taught one at a time using verbal and visual prompts, modeling, hand-over-hand guidance, or video modeling. Chaining has been successfully used to teach children with ASD a variety of new and important skills, such as getting and preparing snacks independently (e.g., Ergenekon, Tekin-Iftar, Kapan, & Akmanoglu, 2014; Shrestha, Anderson, & Moore, 2013), language and communication skills (e.g., Albert, Carbone, Murray, Hagerty, & Sweeney-Kerwin, 2012), simple play and leisure skills (e.g., Ergenekon et al., 2014), and complex basketball skills (e.g., Lambert et al., 2016), as well as task completion (e.g., Lalli, Casey, & Kates, 1995).

Discrete Trial Training Discrete trial training (DTT) has been demonstrated to be effective in teaching individuals with ASD a great variety of skills in communication, adaptive, and social skills (e.g., Shillingsburg, Bowen, & Shapiro, 2014). DTT is a highly structured method for teaching new skills and consists of many opportunities, or trials, to learn and practice a specific skill. DTT is usually delivered in one-on-one settings with teachers who have been trained in the method. Each trial generally consists of a prompt or cue from the teacher, a response from the student, and a consequence. For example, a teacher who is helping a student learn to name or ask for a preferred play item may show the item to the student and provide a brief verbal cue; when the student names the item, he or she is rewarded with time with the item. DTT is fast-paced, with each trial lasting only a few seconds and the opportunity to conduct many trials in a brief amount of time. Depending on the need of the student and where she receives services, students with ASD may receive several minutes up to hours of DTT. DTT may be combined with strategies such as errorless learning or prompt fading to help the student learn the correct response.

Functional Communication Training For children with language impairments, difficult behavior can sometimes be a means of communicating wants and needs. ABA and functional communication training (FCT) assumes that all behavior, including problematic behavior, is a means for obtaining preferred consequences (Iwata, Pace, Kalsher, Cowdery, & Cataldo, 1990). The goal of FCT is teach children a new, more appropriate behavior that results in the same preferred consequence but without problematic behavior. For example, if one assumes that a child who crumples up and throws a work sheet across the room is communicating, "this

is too hard for me, I can't do this," the child can be taught an alternative that conveys the same message in a more socially appropriate manner. In FCT, communication does not always mean speaking or verbal behavior. Communication may also involve the use of sign language, physical movements, pointing to picture icons, or another form of assistive technology. In addition to teaching and increasing communication skills, FCT has been found to decrease the problem behavior (e.g., temper tantrums, aggression, SIB, property destruction) that, before implementation of FCT, was the means of communication (e.g., Durrand, 1991; Durrand, 1993). In one example, Wacker et al. (1990) found that, for one child, self-injury (e.g., hand-biting) often resulted in the presentation of preferred items. The researchers taught the child a method for requesting (e.g., signing) and consistently provided preferred items when he signed. After implementation of this FCT, requesting via signing increased and hand-biting decreased.

Incidental Teaching In the day-to-day activities of an individual with ASD, there are many opportunities to create a learning trial; incidental teaching purposefully targets these naturalistic opportunities. Incidental teaching involves identifying teaching moments, or moments in which there are naturally occurring antecedents (e.g., a child desires a snack), opportunities to teach (e.g., prompt behavior or requesting snack), and consequences (e.g., child is given snack). For example, a child who reaches for a snack may be first required to do a number of things before obtaining that snack. If the child knows the name of the snack, he may be prompted to request the snack by naming it, using a full sentence directed toward the parent, or initiating joint attention. For children who struggle with communication, incidental teaching can dramatically increase the number of opportunities for them to learn and practice communication skills. Incidental teaching generally usually revolves around items the individual finds motivating such as preferred toys, activities, or foods.

Incidental teaching was initially developed and used with typically developing preschool children (Hart & Risley, 1968) but has also been utilized with children with ASD. Incidental teaching is often used to increase language and communication skills (e.g., Farmer-Dougan, 1994; Hsieh, Wilder, & Abellon, 2011; Kroeger & Nelson, 2006; McGee, Krantz, Mason, & McClannahan, 1983) and social skills (e.g., McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992) of children with ASD. Because incidental teaching does not usually require much time or extra materials, teachers (e.g., Kroeger & Nelson, 2006), parents (e.g., Hsieh et al., 2011; McGee et al., 1983), paraprofessionals (e.g., Rispoli, Neely, Lang, & Ganz, 2011), and even peers (e.g., Farmer-Dougan, 1994; McGee et al., 1992) can be taught to use this strategy, increasing the breadth of implementation.

Modeling Modeling as an instructional strategy is utilized just about anywhere instruction occurs, and the model can be anyone including teachers, parents, peers, and videos. The individual can even model the target behavior himself to be viewed later in video. Modeling behavior has been used with individuals with ASD to teach a variety of behaviors including social communication skills, functional skills, and behavioral functioning (e.g., on-task engagement; Bellini & Akullian, 2007). In one example, Garcia, Dukes, Brady, Scott, and Wilson (2016) successfully used modeling to teach children with ASD six fire safety skills. The intervention included the experimenter modeling the verbal and physical behavior required for the appropriate skills before prompting the child to practice the behavior.

Prompts A prompt is a stimulus that helps the learner respond or answer correctly. A prompt differs from other forms of error correction because a prompt comes before the response. A prompt may provide the complete correct response such as when a student is asked to name an apple and the parent provides the prompt, "apple." A portion or part of the correct

response may also be given such as giving the prompt, "aaaaa." Prompts can be verbal, physical (e.g., hand-over-hand guidance), or visual (e.g., finger to lips to remind students to be quiet). It is recommended that the least-to-most principal is used when prompting which consists of using the least intrusive or least supportive mode of prompting that is needed. For example, saying "aaaa" is less supportive than saying "apple." In one study, researchers used gestural (least prompt) or physical (most prompt) prompts to teach children with ASD to follow the gaze of the experimenter (Gunby, Rapp, Bottoni, Marchese, & Wu, 2017). If the child was unable to find the target item by following the experimenter's gaze alone, the experimenter gave a gestural prompt (least supportive), then a physical prompt (most supportive) if needed.

Shaping Shaping is a common strategy in ABA utilized to change or shape behavior to match a target behavior. Behavior is shaped by everyday life in numerous ways, with the most common example being language acquisition (Miltenberger, 2012). The speech of young children is shaped over time to resemble adult speech. Correspondingly, behavior is changed through shaping by reinforcing new approximations of behaviors. Shaping has been utilized in isolation but is more commonly combined with other strategies. Although parents, teachers, therapists, and interventionists have utilized shaping procedures most often to increase and improve the language and communication skills of children with ASD (e.g., Newman, Reinecke, & Ramos, 2009), shaping has also been utilized to change other behaviors, even to increase tolerance toward fearful stimuli (e.g., Ricciardi, Luiselli, & Camare, 2006). Nordahl et al. (2016) used shaping, combined with other behavioral strategies, to teach children with ASD to lie still during magnetic resonance imaging (MRI) procedures without sedation. This was accomplished by slowly increasing the duration of time in the MRI while lying very still.

Task Analysis A task analysis consists of a careful breakdown of all the components of a larger task. As mentioned above, tying shoes can be broken down into multiple small components beginning with "cross laces" and ending with "pull loops tight." Task analysis can then combined with other antecedent, instructional, and consequence strategies to teach new skills. In one study, a task analysis was used to identify the steps of ordering food in a restaurant (Cheung, Schulze, Leaf, & Rudrud, 2016). This resulted in a step-by-step prompt that was visually displayed on smart phones and successfully used by children with ASD to independently order food in restaurants.

Consequence Strategies

Interventions that include changing the environment after a behavior has occurred are called consequence strategies. Although antecedent interventions are also important for changing the frequency of behavior, consequences strategies are often used when trying to increase adaptive and prosocial behavior and reduce maladaptive behavior.

Contingency Contracting Contingency contracting involves an explicit contract or agreement about specific behavior(s) and specific reward(s). The contract usually states that should the individual complete specific target behaviors, or avoid undesirable behavior, she is provided the specific reward. Contingency contracts are often used by teachers and parents and may be informal such as spoken agreements or formalized by a contract that is printed and signed. For non-ASD individuals, contingency contracts have been utilized to target a variety of behaviors such as tardiness and disruptive behaviors (e.g., DeMartini-Scully, Bray, & Kehle, 2000), self-care (e.g., Allen & Kramer, 1990), and academics (e.g., Newstrom, McLaughlin, & Sweeney, 1999), and contingency contracts have also been demonstrated to be helpful for children with ASD. In one study, Mruzek, Cohen, and Smith (2007) used contingency contracting with two

children with ASD and ADHD to increase compliance with classroom rules. Implementation included reviewing the contract each morning, the child choosing the reinforcer, and signing the contract.

Delayed Contingencies Although a delay between behavior and reinforcer generally reduces the power of that reinforcer to increase behavior, immediate reinforcement is not always feasible. Therefore, it is often necessary that the delivery of reinforcers be delayed. Delayed reinforcement can be useful for a variety of target behaviors and has been supported in use with individuals with ASD. For example, Dunlap, Koegel, Johnson, and O'Neil (1987) found that a delay in delivery of reinforcement or punishment of up to 5 min was effective in increasing on-task engagement of children with ASD.

Differential Reinforcement Although there are many forms of differential reinforcement, the key components include an inappropriate behavior not being reinforced and instead reinforcing a different behavior. Probably the most common form of differential reinforcement is differential reinforcement of an alternative (DRA), more appropriate behavior. An example of DRA could be when a teacher only calls on "Jake" (the reinforcer) when he raises his hand (appropriate behavior) and not when he calls out her name (inappropriate behavior). Differential reinforcement has been utilized with individuals with ASD to decrease a variety of problematic behavior such as stereotypic or repetitive scripting (e.g., Rozenblat, Brown, Brown, Reeve, & Reeve, 2009; Silla-Zaleski & Vesloski, 2010) and self-injurious behavior (SIB; e.g., Shimoyama & Sonoyama, 2010) and to increase behaviors such as eye contact (e.g., Jeffries, Crosland, & Miltenberger, 2016) and communication behaviors (e.g., Drasgow, Halle, & Ostrosky, 1998). Differential reinforcement is also an important component of functional communication training (FCT).

Extinction Extinction is a strategy used to reduce problematic or interfering behavior by eliminating or withdrawing the reinforcer that was maintaining the behavior. Extinction is a component of differential reinforcement (e.g., not reinforcing the inappropriate behavior). An example of extinction might be when "Jake" was not called on if he called out the teacher's name or when an individual is not allowed to escape from chores because of disruptive behaviors. Extinction may also be used as an individual intervention strategy or in combination with other behavioral strategies. In one study, Bui, Moore, and Anderson (2013) used extinction plus reinforcement with children with ASD to increase their acceptance of food and decrease food refusal. The extinction procedure included non-removal of the food item (i.e., the food was not removed if the child refused the food item) and physical guidance if needed.

Overcorrection Overcorrection is a learning or teaching procedure that consists of requiring the learner to repair an environment or situation beyond the original state. Overcorrection is intended to reduce unwanted behavior and increase the adaptive behavior. For example, a student who swipes his materials off his desk may be required to pick up not only his materials but any other materials or trash that is on the floor. Another form of overcorrection is positive practice in which the target skill is repeated several times following an error. Overcorrection has been utilized in a variety of ways to treat individuals with ASD including reducing stereotypic vocalizations (e.g., Anderson & Le, 2011) and behavior (e.g., Maag, Rutherford, Wolchik, & Parks, 1986); teaching signs (e.g., Hinerman, Jenson, Walker, & Petersen, 1982); and as components in treatment packages to reduce aggressive and destructive behaviors (e.g., Foxx & Meindl, 2007). In the Anderson and Le (2011) study, overcorrection was successfully implemented to decrease the disruptive vocal stereotypy for a child with ASD after differential reinforcement, extinction, and response cost procedures had failed. The overcorrection procedures

included making a "shush" gesture (i.e., raising index finger to his lips) 100 times.

Response Interruption Response interruption involves blocking or interrupting an individual's attempt to engage in a behavior (Azrin, Besalel, Jamner, & Caputo, 1988). Response interruption is also known as response blocking. For example, response interruption and redirection (described below) has been used to reduce vocal stereotypy in children with ASD by telling them to say something (e.g., "say boy"; e.g., Ahearn, Clark, MacDonald, & Chung, 2007; Shawler & Miguel, 2015) after the first occurrence of the vocal stereotypy. Response interruption has also been used, in combination with other strategies, to treat pica (e.g., Hagopian, Gonzalez, Rivet, Triggs, & Clark, 2011), self-injurious behavior (e.g., Azrin et al., 1988), and other behavior problems.

Redirection Redirection includes prompting an individual to engage in an alternative behavior in place of a problematic behavior (Lydon, Healy, O'Reilly, & McCoy, 2013). Students who are off-task in the classroom are of redirected back to their work. Redirection may also include response interruption such as in the example described above. Redirection often helps decrease problematic behavior and increase appropriate behavior. For example, Duker and Schaapveld (1996) used redirection as part of a treatment package which was found to decrease stereotypic behavior and increase on-task behavior in a classroom setting.

Token Economy A token economy is a program in which individuals earn tokens for engaging in target behaviors (Christophersen, Arnold, Hill, & Quilitch, 1972). The tokens are then exchangeable for another object, activity, and privilege. Token economies are flexible in that the target behaviors can include any appropriate prosocial or adaptive skill that is important for the individual or group. For example, tokens could be awarded for completing school work, doing chores, attending therapy meetings, eating, toileting, etc. The tokens could be a variety of tangible (e.g., poker chips, pennies, marbles, stars) or intangible (e.g., points) items. Finally, the tokens can be exchangeable for any number of backup reinforcers such as desserts, TV time, or money. Token economies generally focus on awarding tokens for target behaviors and avoid, at least initially, removing tokens for bad behavior. However, even though this strategy is primarily about increasing desirable behavior, undesirable behavior often decreases as desirable behavior increases. For example, Carnett et al. (2014) found that, not only was a token economy effective for increasing the rate of on-task academic behavior for a child with ASD, the frequency of his challenging behavior (e.g., screaming, falling to floor) decreased as well.

An Introduction to ABA-Based Early Intervention Models

In response to the increased prevalence of ASD, as well as parent and stakeholder demand for high-quality clinical services, several comprehensive, theoretically grounded interventions have been developed for young children with ASD (Eldevik et al., 2009; Odom, Boyd, Hall, & Hume, 2010). These comprehensive ABA-based intervention packages harness the additive benefits of behavioral techniques and draw from developmental and educational theory to varying degrees (Howlin, Magiati, & Charman, 2009). They also vary by intended setting, with some designed for the classroom, others within a controlled clinic environment, and yet others that are designed to be implemented flexibly across settings (Corsello, 2005). Practitioners may select from focused intervention packages, which are designed to address target behaviors over a short period, or comprehensive treatment models, which are designed to have a broad developmental impact on the core deficits of ASD (Odom et al., 2010).

Across the wide range of ABA-based programs available, there are an expected set of core features, including focus on *early* childhood

intervention (beginning at age 3), intensive programming (20–40 h per week), individualized treatment goals, incorporation of multiple ABA-based procedures, one-to-one treatment format with gradual transition to group settings, developmentally informed treatment goals, parent training, and generalization of new skills to other settings (Corsello, 2005; Lovaas, 1987). Interventions for ASD based on ABA techniques are well-represented in the literature and are broadly demonstrated to be effective in reducing symptom frequency and increasing adaptive skills (Foxx & Meindl, 2007; Schreibman et al., 2015; Smith & Iadarola, 2015). In most cases, ABA is the only therapy approach recognized by funding agencies and legislators to effectively treat core ASD symptoms and aberrant behaviors (Foxx, 2008; Odom et al., 2010; Roane, Fisher, & Carr, 2016).

Although some studies have revealed no differences between treatment and control (or treatment-as-usual) groups (Kovshoff, Hastings, & Remington, 2011; Magiati, Charman, & Howlin, 2007), the overwhelming consensus of well-designed randomized controlled trials and meta-analyses of early intervention programs supports ABA programming for young children with ASD (Foxx, 2008; Reichow, 2012; Smith & Iadarola, 2015). For example, one meta-analysis of 22 clinical trials examining comprehensive ABA for young children with ASD found that this intervention yielded medium-to-large effects in the domains of intellectual functioning, adaptive skills, language development, and social functioning (Virués-Ortega, 2010). While well-established ASD intervention programs include ABA-based, empirically supported individual strategies, there are substantial differences in the amount of evidence across the different intervention programs. The UCLA Young Autism Project (Lovaas et al., 1981) has consistently been identified as a specific program with the strongest evidence for efficacy (Rogers & Vismara, 2008).

Furthermore, efforts have been made to examine the child-level and treatment-level variables that moderate treatment effectiveness. The most robust finding across randomized controlled trials was that higher pretreatment cognitive ability (as measured by IQ) predicts better treatment outcome (Eldevik et al., 2009). Another study found that the more socially mediated reinforcers and fewer stereotypic behaviors explained 50% of the variability of intervention gains (Klintwall & Eikeseth, 2012). Other possible moderating factors include younger age and higher social and object interest (Smith & Iadarola, 2015). Much less is known about demographic influences on treatment outcome, such as race, ethnicity, and socioeconomic status. Regarding treatment-level factors, increased treatment intensity has predicted greater changes in IQ and adaptive behaviors, and inclusion of a parent training component may predict improvements in child adaptive behaviors (Makrygianni & Reed, 2010). Empirical evidence for these moderating factors remains limited.

Since the emergence of clinical trials for ABA in the early 1960s, efforts have been made to fine-tune the effectiveness of this approach, especially regarding long-term outcomes and generalization of learned skills (Smith, McAdam, & Napolitano, 2007). Over time, developmentally sensitive and naturalistic approaches, grounded in developmental theory, have been integrated with ABA techniques with promising effects. That is, complementary techniques such as natural rewards, child-preferred materials, and natural treatment contexts were conceptualized to address core issues among children with ASD, including engagement, motivation, joint attention, and functional communication (Schreibman et al., 2015). Indeed, ABA programs with naturalistic components have yielded more natural language, increased habituation to everyday distractions, increased social development, and improved generalization of skills (McGee & Daly, 2007).

The following overview represents a selection of comprehensive and focused treatment models, all of which vary in theoretical underpinning, reported efficacy, replication, and clarity of procedures (Odom et al., 2010). Treatments are discussed both by name as well as relative level of efficacy and methodological rigor, consistent with the most updated *JCCAP* guidelines of classification (Smith & Iadarola, 2015). The models

described serve as an attempt to spotlight the most validated approaches, as well as to highlight variability in underlying theory and practice elements.

Treatment Models for ASD

UCLA Young Autism Project/Lovaas Method The UCLA model of intervention, often referred to as the Lovaas method and early intensive behavioral intervention (EIBI; Lovaas et al., 1981), is one of the first comprehensive treatment programs for young children with ASD, and it continues to be one of the most popular and requested by caregivers and other stakeholders (Reichow, 2012). This model emphasizes intervention beginning at age 3 or younger, with one-on-one, individualized instruction up to 40 h per week, with a total duration of about 3 years (Smith & Lovaas, 1998). Furthermore, parents serve an integral role on their child's intervention teams. Treatment consists of several "phases" that emphasize different behavior analytic techniques and settings. The primary goals of the UCLA model are to maximize success and minimize failure and frustration due to failure to communicate (Smith & Lovaas, 1998).

During the first several phases of the UCLA model, treatment largely takes place in the child's home. Clear instructional sequences and DTT procedures are utilized to give predictable structure to the learning situation and provide multiple learning opportunities (Reichow, Barton, Boyd, & Hume, 2012). Although treatment goals are individualized, nonverbal and verbal imitation, toy play, self-help skills, and receptive language skills are often emphasized in these initial phases (Smith & Lovaas, 1998). Supplementary treatment components, such as a picture exchange communication system (PECS), are utilized if early success is limited. As children transition to the latter phases of the program, naturalistic instruction techniques like those described below in pivotal response treatment (PRT) are utilized to ensure generalization (Corsello, 2005). That is, skills are practiced across situations and with different people, including typical peers (Reichow et al., 2012). Common goals during these phases include increasing expressive and early abstract language, interactive play, working independently, and gradual introduction to mainstream classroom settings. Termination typically involves a consultation with parents and the intervention team to determine the most appropriate placement for each child (e.g., mainstream preschool or kindergarten; additional home instruction).

As described above, the UCLA model has consistently been highlighted as an effective comprehensive treatment package for treating those with ASD (Smith & Iadarola, 2015), given the quality and quantity of empirical support available (Sallows & Graupner, 2005). However, it should be noted that compared to the original effectiveness study (Lovaas, 1987), replication studies (e.g., Smith, Groen, & Wynn, 2000) have not found such drastic differences between experimental and control groups on variables such as IQ. Furthermore, the original study methodology was limited by nonrandom assignment to groups, oversampling higher-functioning children with ASD, group differences in sex ratio, and failure to measure treatment fidelity (Gresham & MacMillan, 1998). Furthermore, some researchers found the developers' claim that the UCLA program could restore children to "normal functioning" problematic (Schopler, Short, & Mesibov, 1989).

Pivotal Response Training (PRT) This comprehensive treatment approach attempted to improve the time and labor-intensive nature of early interventions for ASD (Koegel, Koegel, Vernon, & Brookman-Frazee, 2010). Specifically, PRT posits that if core areas in functioning are targeted for intervention, the resulting changes will set the context for widespread changes in other areas. The pivotal areas targeted in this intervention include motivation to respond to environmental and social stimuli, self-initiation (e.g., joint attention, question asking), and socialization (Koegel et al., 2010). The specific techniques utilized include within-

stimulus prompting, in which the relevant components of a stimulus are exaggerated to attract attention; following the child's lead and offering choices; placing an emphasis on natural rewards; reinforcing attempts to respond or socialize; and interspersing maintenance trials. This intervention can be flexibly implemented across settings, allowing the child to take advantage of natural learning opportunities that arise throughout the day. The primary goal of PRT is to decrease the child's need for adult support and to reintegrate that child into the natural environment (Koegel et al., 2010). Empirical studies examining PRT demonstrate that this approach is effective in increasing social communication skills (Smith & Iadarola, 2015), as well as decreasing repetitive and disruptive behaviors (Koegel et al., 2010). Currently, PRT is designated as an "established" treatment package for ASD (National Autism Center, 2015).

Learning Experiences: An Alternative Program for Preschoolers and Parents (LEAP) LEAP is a classroom-based comprehensive ABA program (Harris & Handleman, 1994) that is most notable for its emphasis on teaching children with ASD along with their typical peers in a small, structured classroom setting. The program incorporates both behavior analytic techniques and incidental teaching by teachers and peer-mediated techniques that increase social interactions, and its learning experiences often occur in the context of peer-led play opportunities. The primary goal of the LEAP program is to reduce the frequency and severity of ASD symptoms that hinder their learning opportunities (Boyd et al., 2014). One large-scale cluster RCT comparing LEAP compared to treatment as usual found the LEAP resulted in large, positive effects on developmental quotient, language, and social interaction, as well as moderate reductions in ASD symptoms (Strain & Bovey, 2011). However, due to mixed evidence of efficacy across studies, LEAP is currently considered a "possibly efficacious" treatment program for ASD (Smith & Iadarola, 2015).

Early Start Denver Model (ESDM) The ESDM is a comprehensive behavioral intervention designed for infants as young as 12 months that integrates behavior analytic techniques with developmental and relationship-based approaches (Rogers & Dawson, 2010). This program occurs either within the toddler's natural environment or a clinic setting, with trained therapists and parents serving as the interventionists. Participants receive both individualized and small group therapy through this approach. Teaching principles are embedded in play and natural routines that are intended to address multiple developmental objectives. Objectives include increasing positive affect, pragmatic and reciprocal communication, and flexible play skills, with the goal of increasing children's attunement to their social environment.

There is emerging evidence on the efficacy of ESDM among young children with ASD, as evidenced by an RCT that demonstrated medium to large positive effects of the intervention on developmental quotient and adaptive behavior. The intervention only yielded small, nonsignificant improvements in ASD symptoms (Dawson et al., 2010). ESDM may also serve to reduce maladaptive behaviors commonly observed among children with ASD (Fulton, Eapen, Črnčec, Walter, & Rogers, 2014). Taken together, ESDM is currently regarded as a "possibly efficacious" intervention package (Smith & Iadarola, 2015).

Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) This comprehensive intervention is rooted in several theoretical frameworks, including social learning, developmental, and behavioral, and is considered an idiosyncratic model (Odom et al., 2010). The TEACCH model emphasizes structured teaching experiences and a close working relationship between caregivers and practitioners (Marcus, Lansing, Andrews, & Schopler, 1978). Specifically, the learning environment is organized in ways that optimize learning and minimize frustration and utilize visual support. This program places a strong emphasis on skills that

are important for future independence, as it conceptualizes ASD as a lifelong condition. Although TEACCH has been implemented across settings, it typically occurs within a self-contained classroom (Boyd et al., 2014).

Empirical support for TEACCH continues to be somewhat limited, despite its existence for over 40 years. The studies conducted on TEACCH have varied in the treatment components utilized as well as the study design, which have made the ability to draw conclusions about intervention efficacy difficult. However, a recent meta-analysis found that the intervention yielded moderate to large gains in social behavior and decreases in aberrant behavior, as well as negligible-to-small gains in adaptive behaviors (Virués-Ortega, Julio, & Pastor-Barriuso, 2013). Interestingly, the benefits of this intervention appear to increase with age, with adults experiencing the greatest benefit.

Parent Training Active involvement of parents and caregivers was a component of all the described ABA-based treatment packages and is emerging as an important driver of observed outcomes (Strauss et al., 2012). Focused parent training has also been evaluated as a stand-alone intervention that is both cost-effective and directly relevant to the behaviors parents often report as most challenging, such as communication difficulties and tantrum behaviors (Smith & Iadarola, 2015). These interventions are often adapted from those originally intended to be delivered by a teacher or paraprofessional. The primary benefit of parent training interventions is increased generalization and maintenance of acquired skills in a natural environment (Strauss et al., 2012).

Research examining the effectiveness of ABA-based parent training programs has been promising, with one RCT comparing parent-implemented PRT with a psychoeducational control group (Hardan et al., 2015) and finding improvements in the treatment group across measures of spoken language and global social communication functioning. Other controlled trials have yielded mixed findings, with moderate effects of parent training on child communication and minimal effects on ASD symptoms (Green et al., 2010). As such, stand-alone ABA-based parent interventions are considered "possibly efficacious" (Smith & Iadarola, 2015). Efforts have been made to develop and evaluate parent training programs with both ABA and developmental components, but the evidence has been limited, resulting in an "experimental" designation of such programs (Smith & Iadarola, 2015). Interestingly, the class of parent training programs that has the strongest empirical grounding (and a corresponding "probably efficacious" designation) is those rooted exclusively in developmental processes (e.g., Floortime; Greenspan & Wieder, 1997). This finding is compelling, given limited scientific evidence for play-based interventions for children with ASD (Foxx, 2008). Nevertheless, efforts to expand access to intervention services should consider non-ABA parent training as a complementary approach to ABA-based child intervention if it is emergent as the most efficacious approach available.

Limitations and Future Directions

As described above, while some ABA-based interventions are vetted with high-quality randomized controlled trials (Foxx, 2008), many study designs and meta-analyses do not meet the minimum standards of intervention methodology (National Research Council, 2001; Reichow, 2012). Furthermore, researchers often fail to include fidelity data (Howlin et al., 2009), and treatment efficacy is difficult to evaluate across studies. Such variability in methodological rigor results in professional and layperson disagreement regarding the optimal treatment for children with ASD (Howlin et al., 2009).

Furthermore, from a treatment perspective, comprehensive interventions require significant family investment and interventionist training, and they present significant financial burden to stakeholders. As such, program developers should devote time to ongoing development of focused ABA treatment programs and brief parent interventions that approach the efficacy of comprehen-

sive programs. Furthermore, efficacy research should prioritize outcomes generated by parents, providers, and other stakeholders. This call for stakeholder involvement in research is consistent with the goals of Patient Centered Outcomes Research (PCOR), which may incrementally improve intervention delivery and outcomes.

Nevertheless, ABA-based interventions continue to represent the first-line treatment option for children with ASD. These interventions should include an intensive, comprehensive, and individualized treatment protocol, skilled therapists or paraprofessionals delivering the intervention, and strong parental involvement (Reichow, 2012). There is continuing demand for high-quality, evidence-based intervention among this population, given continuing demand with growing prevalence rates (Jacobson, 2000), and it is imperative that information about these treatments continue to be disseminated in a clear and informative manner to parents, professionals, and other stakeholders.

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