

A Brief History of Contributions of Applied Behaviour Analysis to Autism Treatment



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Early proponents of behaviorism began their academic training in psychology. The work of early behaviorists such as J.B. Watson (e.g., Watson, 1913, 1919; Watson & Rayner, 1920) and B. F. Skinner (e.g., Skinner, 1930, 1938) was a departure from traditional psychological theories that contributed to development of a distinct science of behavior. In essence, the key features of behavior analysis that distinguish it from other psychological approaches include behavior as the subject of measurement and the focus of analysis examined within a natural science framework, investigation of environmental determinants of behavior, conceptualization of private events (e.g., thoughts, emotions) as behavior, and the lawful prediction and control of individual behaviour. As a natural science, behavior analysis is concerned with the description, prediction, and understanding of behavior in the physical world (Cooper et al., 2020). As such, behavior analytic research is guided by the principles of *determinism*, *experimentation*, *empiricism*, *reliability*, *philosophic doubt*, and *parsimony* (Cooper et al., 2020). The term behavior analysis encompasses both the science and practice of the science, which can be organized into three branches: (a) *behaviorism* involving theory and philosophy, (b) the *experimental analysis of behavior* (EAB) which includes the empirical analysis of principles of behavior or basic research, and (c) *applied behavior analysis* (ABA) which is the application of the principles derived from EAB to clinical practice, mainly with humans (although behavior analysis is also used to modify the behavior of animals such as pets and zoo animals).

This chapter provides a brief history of behaviour analysis from approximately 1910 to the present. The sections of the chapter are organized into time periods and

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based on major developments in research and/or clinical practice, with particular focus on autism spectrum disorder (ASD). The chapter also highlights an important and often controversial part of the history of behavior analysis—the use of default technologies (i.e., the use of increasingly intrusive or punishment-based procedures following previous attempts to reduce behaviour with ineffective interventions; Cooper et al., 2020, p. 630) and/or misuse and misrepresentations of behavior analytic strategies. To provide clarification on this matter, discussion of some common misuses and misrepresentations of behaviour analytic strategies are addressed.

1910–1930: A Paradigm Shift

Influencing both philosophy and research, John B. Watson (e.g., Watson, 1913, 1919) called into question the dominant perspective that mental processes controlled overt behaviour and instead proposed that physiological processes (e.g., muscle movement, neurological activity) and behaviour-environment relationships were the pathway to understanding what drives human behaviour (Pierce & Cheney, 2013, p. 16). Following in the footsteps of studies by Ivan Pavlov (1927, 1960), Watson examined stimulus-response relations in animals, in particular the formation of conditioned responses via stimulus-stimulus pairing. In a landmark study, Watson and Rayner (1920) conditioned a fear response to a white rat in an 11-month infant, which, although not replicated, formed a rationale for viewing emotions as behavior that can be conditioned and provided the basis for research on conditioned fear responses and the behavior therapy work of Mary Cover Jones (1924) and Joseph Wolpe (e.g., 1958, 1968).

Watson's research helped usher in a new era in psychology, shifting the focus from a mentalistic conceptualization and the paradox of mind-body dualism that dominated the field of psychology in the nineteenth century (Moore, 2010) to one focused on observable behaviour and the study of environmental relations between behaviour and particular stimuli.

1930–1950: Operant Behaviour in the Lab

Building on conditioned reflexive behaviour (Pavlov, 1927, 1960) and conditioned responses (e.g., Watson & Rayner, 1920), Skinner also sought to expand understanding of behaviour-environment relations to behaviours that were considered to have mentalistic causes (e.g., drives, mental images, free will). In hundreds of laboratory experiments during the 1930s to 1950s, Skinner's work led to the discovery that non-reflexive behaviour, or behaviour that is not elicited by preceding stimuli, is controlled by particular environmental stimuli that follow the behaviour and are contingent on its occurrence. Skinner (1938) coined the term *operant* to refer to behaviour that is controlled by a history of response-contingent consequences.

Skinner's identification of *contingency* (i.e., S-R-S; Skinner, 1938) created a paradigm shift in the understanding of behaviour as a function of antecedent *and* consequence stimuli that today is a guiding principle for behaviour analytic research and practice. Skinner adopted concepts and terminology from Pavlov (e.g., conditioning, extinction; Michael, 2004).

In thousands of carefully controlled experiments Skinner demonstrated that the systematic application of different antecedent and consequent stimuli produced reliable and predictable patterns of behaviour change in animal subjects (e.g., rats and pigeons; see Ferster & Skinner, 1957; Skinner, 1938). Two important types of consequences of behaviour are positive and negative reinforcement. Positive reinforcement involves a stimulus, called a *positive reinforcer*, which, when it follows an arbitrary response (e.g., a lever press), increases the frequency of that response (Skinner, 1953, pp. 171–173). An example is food for a hungry (i.e., food-deprived) rat. Negative reinforcement involves a stimulus, called a *negative reinforcer*, which, when it is removed following an arbitrary response, increases the frequency of that response. An example is a moderate electric shock (i.e., the shock is removed after a lever is pressed).

In collaboration with colleagues and students, Skinner developed and refined new methodology (e.g., measures of behaviour in terms of frequency) for the experimental analysis of behaviour. These conventions persist in visual analysis and single-case experimental design today. Skinner's approach to research was adopted by many early psychologists. His early behavioural-pharmacological studies examined the effects of drugs (e.g., caffeine) on rat behaviour, which influenced others in psychopharmacology (Skinner & Heron, 1937, as cited in Skinner, 1938, pp. 409–416).

1950–1970: Operant Behaviour in the Field

On the brink of a new decade, P. R. Fuller's 1949 study is cited by many as the first to demonstrate that human behaviour functions according to operant principles. His study showed that a positive reinforcement contingency (i.e., contingent delivery of a sugar-milk solution) could be used to teach a catatonic (referred to as “vegetative”) 18-year-old man to move his right arm in just four sessions. Subsequently, behaviour analytic research in the 1950s shifted from laboratory work with animals toward understanding human behaviour. Researchers began to examine whether the same principles of *respondent* (i.e., a response elicited by a preceding stimulus; Skinner, 1938) and *operant behaviour* (responding influenced by its consequences; Skinner, 1938) could be applied to controlled laboratory studies involving humans. Keller and Schoenfeld's introductory text, *Principles of Psychology* (1950), presented an easy-to-understand version of Skinner's research and theory, which helped to pave the way for Skinner's own introductory text, *Science and Human Behavior* (1953), which he dedicated to his close friend Fred Keller (Michael, 2004). The application of operant conditioning principles to helping people in the 1950s and

1960s was termed *behavior modification*. The first publication to use behavior modification in the title was *Case Studies in Behavior Modification* (Ullman & Krasner, 1965), which highlighted many clinical examples of application of operant principles to socially significant problems, including those of children with intellectual disabilities and autism (Martin & Pear, 2019, p. 314). Intellectual disability is characterized by difficulties in intellectual (e.g., problem-solving) and adaptive functioning (e.g., daily living tasks, social behaviours), both of which are prevalent early in a child's development (5th ed.; DSM-5, American Psychiatric Association, 2013).

The majority of behavioural interventions in the 1950s were utilized to understand and improve particular behaviors of individuals with severe mental health concerns (referred to as *psychotic* and *neurotic*) in psychiatric hospitals. Lindsley and Skinner's (1954)'s research at the Harvard Medical School Behavioral Research Lab (1953–1965) spearheaded research on operant behavior in humans and the application of the methods of operant conditioning to human behavior. Their research included the impact of drugs on behaviour of people deemed “psychotic” at the Metropolitan State Hospital. Much of the research coming from this lab during this time focused on the study of operant behavior with psychiatric patients receiving pharmacological treatments. These studies contributed to establishing empirical support for the application of basic behaviour principles (developed in early EAB research) to human behaviour concerns. This period of time also coincided with what is known as the “pharmacological revolution” where pharmacological treatments for mental health concerns were rapidly increasing (Rutherford, 2003).

At the tail-end of this decade, Allyon and Michael's (1958–1961) work at the Saskatchewan Hospital, in Saskatchewan, Canada, further demonstrated the efficacy of operant interventions to understand and improve non-adaptive behaviors (e.g., non-contextual speech, hoarding) of adults with psychiatric disorders (Morris et al., 2013).

1960–1980: Behaviour Analysis Burgeons

Allyon and Michael's 1959 article, “The Psychiatric Nurse as a Behavioral Engineer” ushered in a new branch in behaviour analytic research and practice, *applied behaviour analysis*. Several clinical studies demonstrated that procedures developed in the EAB literature could reduce or eliminate problematic (termed *incapacitating*) behavior in individuals with severe mental health concerns (e.g., Ayllon & Michael, 1959; Ayllon & Azrin, 1965; Wolpe & Lazarus, 1966). Other studies demonstrated that applied behavior analysis could reduce behavioral problems for individuals with autism (Wolf et al., 1963, 1967).

In the mid 1960s, behavioral research began to expand beyond highly controlled laboratory studies and in-patient hospital facilities (and programs) to a wider range of populations and clinical and research settings. For example, D. M. Baer conducted several studies to assess the effects of various contingencies on escape and

avoidant behaviour in preschool children (e.g., Baer, 1960, 1961, 1962). Wolpe's work on *systematic desensitization* (Wolpe, 1958) utilized respondent procedures based in early EAB to address specific phobias and neurotic behaviours (e.g., Wolpe, 1961). In addition, researchers such as Bijou (1955, 1957, 1958) and Ferster and DeMyer (1961) began to examine the efficacy of principles of operant behavior to target behaviours of social significance in individuals with intellectual disabilities (called "mental retardation" at the time) and autism (e.g., Bijou, 1955, 1957, 1958; Ferster & DeMyer, 1961).

The transformation from basic research with animals to applied research with humans, was made possible with a well-established repertoire of behavioural principles from the EAB literature. The outcomes of the operant research with human participants showed not only that human operant behavior was a function of reinforcement and punishment contingencies, but also that the behaviour change observed in these interventions could impact the individual's life in a meaningful way.

A reinforcement contingency is a rule for presenting reinforcement. Reinforcement is the presentation of a stimulus (a positive reinforcer) or removal of a stimulus (a negative reinforcer) following a response that increases the probability of that response occurring in the future. A punishment contingency is a rule for presenting a punisher. It occurs when a particular stimulus is added (a positive punisher) or removed (a negative punisher) contingent on a target behavior that decreases the likelihood of that behavior occurring in the future (Cooper et al., 2020, pp. 36–38). Often, the concept of punishment is associated with the involvement of severe or harmful aversive stimuli, which is not always the case. For example, attention from a specific individual can serve as a punishing stimulus for a person's behaviour if they find attention from that person to be aversive. Similarly, default technologies such as time out procedures (i.e., temporarily terminating access to an ongoing activity/moving an individual to a location that is distanced/isolated from others) may be considered punishment when employed as a response to an individual acting out (e.g., yelling out in a classroom setting); however, this may actually have the opposite effect if the function of the person's behaviour is to escape the situation (i.e., the classroom or the assignment). A solid understanding of behavioral principles is required for effective application of punishment procedures to everyday problems.

A major shift in behaviour analytic research was evident as behavior analysts began to focus their attention on problems of social significance and the application of interventions in community settings, while attempting to maintain the tenets of EAB (Fisher et al., 2011). In 1968, the first scientific, peer-reviewed journal devoted entirely to the study of applied behavior analytic research was published. The *Journal of Applied Behavior Analysis (JABA)* complemented the *Journal of Experimental Analysis of Behavior (JEAB)*, which was founded in 1958. In *JABA*'s inaugural publication, Baer et al.'s (1968) seminal article clearly defined the distinguishing features of ABA, specified by seven dimensions: (1) *generality*, meaning the behaviour change maintains over time, and is observed in non-trained environments, and/or the emergence of non-targeted behaviours; (2) *effective*, meaning the

procedures studied produce consistent changes in behavior; (3) *technological*, in that the procedures are described accurately and completely to facilitate replication of those procedures with the same outcomes; (4) *analytic*, meaning there is an attempt to demonstrate a reliable functional relationship between independent variables (interventions) and dependent variables (target behaviors); (5) *conceptually systematic*, in that the procedures utilized are based on empirically established principles of behaviour; and (6) *applied*, in that behaviours that are targeted are of social significance and importance to the individual; and (7) *behavioural*, in that the subject of intervention is behaviour that is objectively observable and measurable.

By the mid-1970s applied behavior analytic research had expanded considerably in scope. Some novel areas included: various classroom management (e.g., Soloman & Wahler, 1973) and skill building procedures to improve student performance (e.g., Glyn et al., 1973), communication and development (e.g., Martin, 1975), toilet training (Azrin & Foxx, 1971), and various applications of token reinforcement systems (e.g., Ayllon & Azrin, 1968; Everett et al., 1974; Fjellstedt & Sulzer-Azaroff, 1973). Furthermore, research demonstrated that mediators (e.g., parents, teachers, peers) could be trained to implement behavioural data collection procedures and interventions in natural settings, increasing the *generality* of these interventions (e.g., Aragona et al., 1975; Copeland et al., 1974; Johnson & Bailey, 1974).

This was also a period of significant growth in the development of clinical ABA interventions for persons with intellectual and developmental disabilities (IDD) and ASD. The term developmental disability encompasses a spectrum of conditions including, cerebral palsy, intellectual disabilities, and communication disorders (Accardo & Capute, 2008, p. 16). Some of the most influential work in applied interventions for behaviours associated with ASD is Lovaas and colleagues' (e.g., Lovaas et al., 1973) early research demonstrating the reduction of problematic behaviours and increase in language and adaptive skills in children with ASD. Lovaas and his colleagues' initial studies (Lovaas et al., 1965, 1966) were based on Ferster's (1961) theory of an environment lacking in reinforcement whereby contrived reinforcers could be established. Despite Lovaas and his colleagues' interventions being efficacious, the authors indicated that the procedures were too cumbersome and impractical to use outside of a controlled treatment environment. Later studies (Lovaas, 1969; Lovaas et al., 1967) examined the use of punishment and extinction procedures to reduce self-stimulatory, self-injurious, and/or tantrum behaviors. Additionally, Lovaas targeted building adaptive behaviours, including verbal and non-verbal language, self-care (e.g., toothbrushing), and social communicative behaviors (e.g., greetings).

Other major contributing factors in the growth of ABA research and practice during this time included the creation of university programs that offered formal training in ABA (e.g., Florida State University, Arizona State University, University of Kansas, Universities of Illinois and Southern Illinois, Indiana University, & the University of Oregon), and the development of associations to establish, promote, and disseminate the ethical practice of behavior analysts. For example, in 1973 Garry Martin and Joseph Pear formed the Manitoba Behavior Modification Association (Walters & Thomson, 2013). The Mid-Western Association for

Behavior Analysis was formed in 1974 which later became the Association for Behavior Analysis International.

Concerns about the misuse of behavioral technology began shortly after ABA hit its stride in the 1960s and 1970s. For example, Stein (1975) highlighted ethical considerations regarding brief workshops on how to implement behavioral technology. There was concern that people were misapplying “bits and pieces” of behavioral technology non-systematically. The field also began receiving criticism about the misuse of behavioral principles. It is unclear how often behavioral procedures were misused by people without adequate training although misrepresentations existed within academia and the general population. For further discussion of the misrepresentation of behaviour modification and behaviorism see Leslie (1997) and Todd and Morris (1992), respectively.

One of the most infamous cases of misuse and misrepresentation of behavioral methods involved clients receiving unethical treatment at Sunland Institution, Florida, in 1972. In response to this situation, significant changes were implemented to protect the current and potential clients receiving behaviour modification in the state of Florida. A joint task force comprised of nine highly regarded individuals from behaviour analytic, disabilities, and legal communities was formed with a mission to define philosophies, procedures, and safeguards for behavioral programs in the state. The process resulted in a detailed report with guidelines for practice by the Florida Division of Retardation. Some of these guidelines included formal recommendations for legislation to support the guidelines, establishing a State Coordinator for behavioral programming, providing funding for graduate training in ABA, and the development of a training program for behavioural interventions. The final report (1974) is considered by some to have helped establish behaviour analysis as the primary model for treatment of individuals with IDD (Johnson & Shook, 1987).

1980–2000: Applied Behaviour Analysis as an Evidence-Based Intervention for ASD

Prior to reviewing the developments in ABA interventions for individuals with ASD, it is important to first contextualize these with a brief description of the major adaptations in diagnostic criteria for ASD. The understanding and description of the defining behaviours characteristic of ASD has changed considerably since its introduction to the *Diagnostic and Statistical Manual of Mental Disorders* in 1980 (DSM-3; APA, 1980). At that time, autism was included under the class of disorders termed *pervasive developmental disorders* with two sub-categories, “infantile autism” and “residual infantile autism”. The DSM-3 criteria for autism were controversial, particularly with regard to the multiaxial approach to diagnosis, the lack of description of the heterogeneity of behaviours associated with autism, and the forced categorization of individuals into infantile or residual autism; thus, it was revised in 1987 as the DSM-3-R (Volkmar, 2013, pp. 999–1002). This was followed

by a second major shift with the advent of the DSM-5 (American Psychiatric Association, 2013). The changes included the condensing of two of three major diagnostic criteria—*social impairment* and *language deficits*—into one, now termed *nonverbal communicative behaviour*. In addition, a severity assessment scale was added to give an indication of the level of support or intervention needed to improve behaviour. Finally, with the wide heterogeneity of behaviours observed in individuals labelled with an autism-related diagnosis and the considerable overlap among what was previously known as *autistic disorder*, *Asperger's syndrome*, *childhood disintegrative disorder*, and *PDD-NOS*, these four diagnoses were considered to be separate conditions on the autism spectrum. Today, the defining features of ASD include, “deficits in social-emotional reciprocity, nonverbal communicative behaviour, and developing, maintaining, and understanding relationships” (DSM-5; American Psychiatric Association, 2013). Common comorbidities observed in individuals with ASD include language impairment, catatonia, and other neurodevelopmental, mental health, and behavioural disorders (LeMay et al., 2019).

In the mid 1980s, understanding of the behaviours associated with ASD, their functions, and efficacious interventions to improve behavioural challenges or concerns was sparse. Furthermore, despite budding empirical support for the use of behavioural interventions for persons with ASD, the bulk of research seemed to indicate that gaps in the acquisition of typical developmental milestones and the presence of challenging behaviours in individuals with ASD were permanent or largely untreatable (DeMyer et al., 1981).

Lovaas's UCLA Young Autism Program (1987)

In 1987, O. I. Lovaas published the first intensive ABA intervention for children 4 years of age or younger diagnosed with ASD. This marked one of the most important research and clinical developments in ABA. Lovaas's *Young Autism Program* (Lovaas, 1987) included intervention sessions 5–7 days per week, for an average of 40 h per week, initially with a therapist-client ratio of one-one. Each intervention targeted behavioural reduction of challenging behaviours (e.g., aggression, self-injurious behaviours) and the development of language, social skills, emotional expression, pre-academic skills, and observational learning. The behavioural strategies used included extinction (i.e., planned ignoring), positive and negative punishment (e.g., time-out, loud “no”) contingent on the occurrence of challenging behaviour, and shaping of behaviours targeted for increase or acquisition.

Analogous to the distinction between positive and negative reinforcement, the distinction between positive and negative punishment involves the addition or removal of a stimulus, respectively, following a target behaviour. A *positive punishment* procedure involves the addition of a stimulus (e.g., a reprimand) following the target behaviour that decreases the subsequent occurrence of that behaviour (Catania, 2011, p. 47; Martin & Pear, 2019, p. 167; Pierce & Cheney, 2013, p. 156). Conversely, a *negative punishment* procedure involves the removal or termination of

a stimulus (e.g., loss of points) following the target behaviour that decreases the subsequent occurrence of that behaviour (Pierce & Cheney, 2013, p. 157). It is important to note that corporal punishment is not recommended. Formal guidelines for the ethical use of punishment procedures were not established until the development of the Behavior Analysis Certification Board (BACB) and, in particular, the *Professional and Ethical Compliance Code for Behavior Analysts* (“the code”; BACB, 2014). This code states that behavior analysts must (a) “...recommend [positive] reinforcement rather than punishment [or negative reinforcement] whenever possible”; (b) “if punishment procedures [or negative reinforcement] are necessary, behavior analysts always include [positive] reinforcement procedures for alternative behavior...”; (c) “before implementing punishment [or negative-reinforcement]-based procedures, behavior analysts ensure that appropriate steps have been taken to implement [positive] reinforcement-based procedures, unless the severity or dangerousness of the behavior necessitates immediate use of aversive procedures”; (d) “...aversive procedures are accompanied by an increased level of training, supervision, and oversight; (e) “behavior analysts must evaluate the effectiveness of aversive procedures in a timely manner and modify the behavior-change program if it is ineffective [and]...always include a plan to discontinue the use of aversive procedures when no longer needed” (BACB, 2014, p. 13).

A key component in the delivery of the intervention was discrete-trials teaching (DTT) which involves the delivery of specific instructions in a rapid (to maintain a brief inter-trial interval) and repetitive manner, decreasing the presence of any extraneous stimuli in the teaching environment (Roane et al., 2016). The majority of early ABA interventions for individuals with ASD focused primarily on the reduction of challenging behaviours, probably due to the high prevalence of behaviours of this nature in the ASD population and the potential harm they can cause to the individual and others. Prior to formalization of *functional behaviour assessment* (FBA) and function-based interventions, it was not uncommon for interventions targeting the reduction of challenging behaviours to utilize punishment procedures. FBA encompasses a triad of behavioural technologies to assess the purpose or function (i.e., reinforcement) of challenging behaviours and the environmental stimuli that occasion and maintain the behaviour being assessed. The three types of technologies utilized in FBA involve, indirect, descriptive, and functional analysis (sometimes termed experimental or analogue functional analysis; Cooper et al., 2020, pp. 50–58). Indirect and descriptive assessments permit the behaviour analyst to develop hypotheses about the function of the behaviour of interest by identifying antecedent and consequence stimuli, and other relevant contextual variables (e.g., motivating operations); while functional analysis enables the systematic manipulation of particular environmental variables to determine the function(s) (Iwata et al., 1982/1994) of the behaviour being assessed.

Due to the high occurrence of challenging behaviours in the ASD population, FBA is now a major component of the intervention process (Roane et al., 2016). As discussed later, a wealth of empirical research has demonstrated the efficacious reduction of challenging behaviours and simultaneous increase of functional replacement behaviour(s) via the use of FBA and subsequent function-based

interventions (e.g., Beavers et al., 2013). FBA is now considered “best practice” by the American Academy of Pediatrics (Roane et al., 2016).

Along with an ever-expanding library of research supporting the use of ABA interventions for individuals with ASD (Cohen et al., 2006; Roane et al., 2016), came legislation to expand services and funding in support of persons with ASD. In 1990 the United States congress reinstated the *Education for All Handicapped Children* with a new name, the *Individuals with Disabilities Education Act* (1990; <https://sites.ed.gov/idea/>), which stipulated that all students with disabilities in the public education system are to be provided with individualized, free special education and early intervention. Part of the mandate for school-aged children included an individualized education plan (IEP) which includes measurable goals to improve academic and functional skills. For individuals with ASD, an IEP may include behavioral assessment and/or intervention to target the individual’s goals (<https://sites.ed.gov/idea/>).

Early Intensive Behavioral Intervention

Grounded in Lovaas’ program (1987), early intensive behavioural intervention (EIBI) involves the application of ABA principles to increase the developmental trajectory of infants and young children in preparation for entry or reintegration to school (Reichow, 2012). Ideal conditions for effective EIBI include weekly session duration of 20–40 h (Reichow, 2012; Lovaas, 1987) with a frequency of 5–7 days per week (Roane et al., 2016), with intervention initially delivered one-to-one in a highly structured and systematic format (Lovaas, 1987), typically in community-based clinical settings. As the client progresses, demonstrating skill development, the potential for group or dyad-based ratios and less structured training techniques can be considered as well as a decrease in the duration and frequency of sessions, all dependent on the unique needs of the client. Also, crucial to the success of the intervention is adequate training of the individual(s) implementing the intervention (Bibby et al., 2001; Green, 1996) and mediator training for caregivers, teachers, or other key individuals in the client’s life to promote maintenance and generalization of outcomes (Lovaas, 1987).

Regardless of the intensity (i.e., duration and frequency of sessions, delivery of instruction) the intervention, teaching targets should target multiple domains and be individualized based on the individual’s current needs but can use well-developed, empirically validated curricula [e.g., *Verbal Behavior-Milestones Assessment and Placement Program* (VB-MAPP; Sundberg, 2008); *Assessment of Basic Language and Learning Skills* (ABLLS; Partington, 2006); *The Me Book* (Lovaas, 1981)] as guides. In accordance with the aims of ABA, intervention goals or targets should be meaningful to the client and readily generalizable in their natural environment.

EIBI is considered to be an evidence-based treatment for individuals with ASD as an abundance of peer-reviewed and empirically validated studies on EIBI have demonstrated considerable improvements in intellectual abilities, language skills,

and adaptive functioning across a large and diverse sample of the ASD population (e.g., Cohen et al., 2006; Sallows & Graupner, 2005). The substantial empirical support for EIBI for persons with ASD contributed to the development of national and state or provincial programs to make EIBI (and other validated services and interventions) more accessible to children with ASD and their families (e.g., Ontario Autism Program [OAP]-The OAP Advisory Panel Report, 2019; New York State Department of Health Early Intervention Program-Clinical Practice Guideline, 1999). In addition, the National Standards Project (National Autism Centre, 2009, 2015) recognized ABA interventions as one of 14 established interventions for children, youth, and young adults (0–22 years of age) with ASD and the *sole* established intervention for adults (22 years of age and older) with ASD (National Autism Centre, 2015). According to the National Standards Project, an intervention meets the established intervention criteria when sufficient evidence is gathered that demonstrates that the outcomes produced are “favourable” and “effective” (National Autism Centre, 2009, 2015). Today, the most commonly implemented and empirically supported interventions for individuals with ASD are derived from ABA procedures, with DTT being the most common procedure implemented with individuals with ASD (Leaf et al., 2016). A later, albeit crucial development in the integration of ABA into mainstream clinical practice involved the 1999 Surgeon General’s declaration of ABA as the treatment of choice for individuals with ASD (New York State Department of Health Early Intervention Program-Clinical Practice Guideline, 1999).

2000–Present: Applied Behaviour Analysis—A Diverse and Progressive Science/Discipline

Research and practice in the area of ABA and ASD has grown exponentially over the past 40 years, from EIBI for infants and children with ASD to interventions targeting daily living skills for adults with ASD and individuals with ASD and comorbid mental health diagnoses. Another area of considerable growth in ABA interventions for persons with ASD includes the use of evidence-based behavioural technologies (e.g., behavior skills training; Parsons et al., 2012; Reid et al., 2003) to train caregivers and other mediators to implement assessment and intervention for individuals with ASD. For example, Johnson et al. (2007) developed a manualized training program to teach caregivers of children with ASD and other DDs to implement ABA interventions to increase adaptive skills and decrease challenging behaviours. Training caregivers to implement ABA interventions with their children not only offers a relatively low-cost and less time-consuming option, but also contributes to increased likelihood that treatment gains will maintain and generalize beyond the specific behaviours and environments involved in the intervention (e.g., Miles & Wilder, 2009; Valdimarsdóttir et al., 2010).

Considerable advancement in addressing challenging behaviours of individuals with ASD (and other client populations) can be attributed to the development of function-based assessment and interventions. Functional Communication Training (FCT; Carr & Durand, 1985) is an example of a function-based intervention that has been shown to be highly effective in reducing the challenging behaviours of persons with ASD. According to recent research, FCT is the most published behavioral intervention for reducing challenging behaviours (Tiger et al., 2008) not only for individuals with ASD, but also those with other IDD, traumatic brain injury, attention deficit disorder, attention deficit-hyperactivity disorder, and speech or language delays, across a wide age range (i.e., children-adults). A review by Tiger et al. (2008) showed that 91 FCT studies were published between 1985 and 2006.

Contemporary behavior analytic interventions maintain the foundational principles of behavior developed in EAB and the verbal operants developed by Skinner (1957) while incorporating strategies from other disciplines, particularly mindfulness-and-acceptance-based therapies and from the ever-growing literature base on post-Skinnerian study of verbal behaviour such as relational frame theory (RFT; Hayes et al., 2001).

Building on research involving training caregivers of children with ASD to implement ABA interventions, mindfulness-based practice has been shown to enhance outcomes of behaviour reduction interventions in addition to reducing caregiver self-reported stress (e.g., Singh et al., 2006, 2007). Another therapeutic method incorporating behavioural principles and mindfulness practice that has received a great deal of attention in recent years is *Acceptance and Commitment Therapy/Training* (ACT; Hayes et al., 2009; Tarbox et al., 2020). ACT is philosophically rooted in behaviorism, RFT, and functional contextualism (see Biglan & Hayes, 1996; Hayes, 1993).

Another method showing increased support in the area of language development for children with ASD is the *Promotion of the Emergence of Advanced Knowledge* (PEAK; Dixon, 2014). PEAK is an assessment tool and intervention protocol that is based on Skinner's (1957) philosophy of language development and RFT (Hayes et al., 2001). The PEAK intervention protocol involves four modules, PEAK-Direct Training (PEAK-DT), PEAK Generalization (PEAK-G), PEAK Equivalence (PEAK-E), and PEAK-Transformation (PEAK-T). PEAK-DT has been shown to be efficacious for developing language skills in children with ASD and shows budding support with adults (e.g., Dixon et al., 2018). Similar to the Lovaas model of EIBI, PEAK-DT utilizes a DTT approach to teach increasingly complex verbal operants.

Summary

Early behaviour analysts, rooted in behaviorism, sought to develop an objective science of behavior. The discovery of conditioned reflexive behavior (Pavlov, 1927, 1960) and the formation of other conditioned responses via stimulus-stimulus pairings (e.g., Watson & Rayner, 1920) paved the way for operant conditioning and EAB. Building on the work of his predecessors, Skinner, his colleagues, and his

students demonstrated that non-reflexive or *operant* behavior was also a product of behavior-environment relations, creating a paradigm shift in the conceptualization of behavior and the advent of EAB. Arguably spurred by Fuller's (1949) study, the next decade in EAB produced a new subset of research demonstrating that the principles of *respondent* and *operant* behaviour could also explain human behavior. Beginning with research in highly controlled environments (i.e., laboratories, in-patient facilities) and primarily with persons with severe mental health concerns, the work of behaviour analysts during the 1950s to 1970s established empirical support for the application of basic behaviour principles (developed in early EAB research) to human behaviour. This shift in focus not only expanded the scope of EAB research, but also the clinical applications of the procedures. Along with the expansion of research in EAB with humans in the 1960s and 1970s came concerns regarding the misrepresentation and misuse of clinical applications of behavioural interventions. In response to the growing body of research and the need for clear guidelines on the ethical practice of behavioural interventions, the first scientific, peer-reviewed journal for the study of applied behavior analytic research was created (the *Journal of Applied Behavior Analysis*) as well as associations to establish, promote, and disseminate the ethical practice of behavior analysis (i.e., Manitoba Behavior Modification Association, the Mid-Western Association for Behavior Analysis).

In 1959, a pivotal study by Allyon and Michael ushered in a critical shift in the clinical practice of behaviour interventions known as ABA. Having established that the principles of EAB could be effectively applied to human behavioral concerns, behavior analysts began to focus their efforts on problems of social significance in community-based environments. Applied behavior analytic research and clinical interventions for persons with IDD also burgeoned during this period of time. Lovaas' (1987) work in the *Young Autism Program* laid the foundation for present-day EIBI, which is now considered an evidence-based intervention for children with ASD. The considerable wealth of ABA literature supporting the use of EIBI has led to widespread government funding in North America, to ensure that EIBI and related behavioral supports (e.g., FBA) are readily available to children with ASD.

More recent research demonstrates that behavioral interventions can be efficacious in addressing a wide range of socially valid behavior concerns for a wide age range of individuals with ASD. In addition, there is growing support for the use of ABA technologies to train mediators (e.g., caregivers, direct-care staff) to effectively implement behaviour analytic assessment and intervention, and to address caregiver stress related to caring for persons with ASD.

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