Applied Behavior Analysis as Treatment for Autism Spectrum Disorder

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EDITOR'S NOTE: As the incidence of autism spectrum disorder (ASD) has increased, it has become clear that there is substantial variability of the children affected by this neurodevelopmental disorder. Likewise, there are a wide range of educational and medical therapies for ASD. Early intensive behavioral and developmental interventions, such as applied behavior analysis treatment addressed in this Medical Progress, have shown benefits in some children with ASD. Nonetheless, the increased awareness of ASD and the screening of a wider range of children for ASD have both resulted in an increasingly heterogeneous population of children with ASD. One treatment may not be appropriate for all children diagnosed with ASD. An increasing range of treatment approaches is on the horizon, and these will require rigorous study across the heterogeneous population of children with ASD.

With an increase in the number of children diagnosed with autism spectrum disorder (ASD)[1] to 1 in 68, family demand for insurance coverage of evidence-based treatments for ASD has increased. To date, 43 states have reformed insurance coverage.[2] The majority of the approved statutes explicitly mandate coverage of treatments based on the principles of applied behavior analysis (ABA). In addition, 24 states have now passed legislation to establish professional regulation of ABA providers, known as behavior analysts.[3] The purpose of the present review is to provide information on: (1) basic principles and procedures of ABA treatments; (2) the body of evidence and strength of studies that support the efficacy of ABA treatments; (3) the matching of these procedures to patients with specific characteristics (eg, toddlers) or symptoms (eg, minimal vocal skills); and (4) the assessment of appropriately trained and credentialed behavior analysts.

Given the inclusion of ABA treatments in insurance reform mandates for ASD along with the increasing impact of ASD on the health care system,[4-6] pediatricians should be familiar with the basic principles and procedures of ABA. This knowledge is particularly important in light of research suggesting that physicians report that familiarity with ABA is associated with increased competency for providing primary care to children with ASD.[7] Pediatricians also should be aware that ABA is a field of study and not just a single treatment for ASD. The principles and procedures of ABA have been used to treat a wide variety of socially important problems, such as academic delays and addiction.[8] For the purposes of this discussion, we will delineate between the field of ABA (henceforth ABA) and the application of behavioral principles to the treatment of disorders such as ASD (henceforth ABA treatments). Finally, it should be noted that this review is not intended to be a comprehensive review of ASD treatments or other evidence-based practices for ASD but is instead a primer on the topic.

The core symptoms of ASD include persistent impairments in reciprocal social interaction and communication and restricted and repetitive behaviors. For example, one area of social communication that is particularly problematic in children with ASD is joint attention.

Joint attention involves the shared focus of 2 individuals on a common object or event.[9] Whereas typically developing children will often look at an interesting object, point at it, and then look at their parent to share the experience, children with ASD are much less likely to engage in such forms of joint attention.

Other areas of impairment include difficulties in expressing and interpreting nonverbal communication, poor eye contact, and difficulties in initiating and maintaining relationships. Restricted and repetitive behaviors seen in children with ASD include repetitive motor movements such as hand flapping, restricted use of objects such as lining up toys, and/or stereotypic speech such as echolalia. Interestingly, the majority of children with ASD do not present with intellectual disability.[1] Therefore, manifestations of ASD symptoms vary widely, leading to a clinical heterogeneity of ASD. For example, one child with ASD may have well-developed verbal skills, no intellectual impairment, and relatively mild forms

ABA	Applied behavior analysis
ASD	Autism spectrum disorder
BACB	Behavior Analyst Certification Board
BCBA	Board-Certified Behavior Analyst
DTT	Discrete-trial teaching
EIBI	Early and intensive behavioral intervention
ESDM	Early Start Denver Model
FBA	Functional behavior assessment
NLP	Natural language paradigm
PECS	Picture Exchange Communication System
PRT	Pivotal Response Training
RCT	Randomized clinical trial

http://dx.doi.org/10.1016/j.jpeds.2016.04.023

of repetitive behavior, whereas another might be "nonverbal" with severe intellectual disabilities and persistent stereotyped behavior patterns. When interviewing caregivers regarding their child's development, pediatricians should proactively inquire about eye contact, joint attention, imitation, gesturing, repetitive behavior, and language, among other developmental milestones.[10] There are a number of available screening procedures (eg, Modified Checklist for Autism in Toddlers)[11] for this purpose. In addition, the nature of any deficits as well as the age of the child are important considerations for determining the appropriate course of treatment.

Theory of ABA and Treatments

The basic principles underlying ABA arose from the research of B. F. Skinner,[12] who posited and later confirmed that behavior was determined through a process called selection by consequences, which is analogous to Darwin's process of natural selection. That is, Skinner demonstrated that in a given environmental context, behaviors that produce favorable outcomes will continue to occur through the process of reinforcement and those behaviors that do not produce favorable consequences will decrease over time, or extinguish. Skinner demonstrated how responses could be developed or changed over time by providing reinforcing consequences for successive approximations (eg, saying a single phoneme) of the final target response (eg, saying a target word), a process called shaping. Other important operant procedures used to establish new responses include prompting and modeling, among others.[8]

Ivar Lovaas developed the first intensive ABA treatment for ASD, which is commonly referred to as early and intensive behavioral intervention (EIBI). As originally conceived, EIBI is a comprehensive treatment model often conducted 5-7 days per week, several hours per day for up to 40 hours per week. Initially, the treatment is delivered in a one-to-one format with focus on the elimination of atypical behavior and the establishment of learning skills. Thereafter, the treatment may become more group oriented and less structured while focusing on more complex cognitive and social skills.[13,14]

The EIBI model developed by Lovaas relied heavily on discrete-trial teaching (DTT), which focuses on teaching skills in a repeated and brief fashion with a specific instruction (the "discriminative stimulus") while minimizing extraneous details, thereby making the instruction "discrete." For example, a child who is being taught to differentiate among 3 shapes might be presented with the brief, specific instruction, "Touch the circle." Correct responses would be reinforced through praise, whereas incorrect responses would produce no such positive reaction or would be correlated with a form of correction, such as the therapist pointing to the correct shape while repeating the instruction. The final and perhaps most critical component of DTT is ongoing data collection and data analysis. Within DTT, data are collected on a trial-by-trial basis or on a subset of trials.[15,16] These data are used to determine the child's rate of progress and

whether procedural modifications are warranted. Generally speaking, DTT and other, more naturalistic forms of ABA (described herein) often are applied to children around age 2 years for 25 or more hours per week to target basic skills such as joint attention, play, or imitation.[17] As children progress in skill development, this model typically is applied for a shorter duration (eg, 15 hours per week) to address more complex social behavior (eg, perspective taking).[18]

Smith and Iadarola[14] reviewed recent evidence on EIBI and other ABA treatments for children 5 years of age and younger with ASD and concluded that 2 interventions met Chambless and Hollon's[19] criteria for a "well-established" treatment, defined as 2 or more well-conducted group-design studies from different research labs: (1) individual, comprehensive ABA (ie, EIBI); and (2) teacher-implemented, focused ABA/developmental approach. Additional support for ABA treatments has come from multiple meta-analyses and systematic reviews,[20,21] which have found that ABA treatment has strong empirical support.

It should be noted, however, that the evidence supporting many focused ABA procedures has come primarily from small-sample studies that use within-subject experimental designs, which are sometimes excluded from meta analyses, rather than randomized clinical trials (RCTs).[21,22] Consequently, the strength of evidence regarding ABA treatments has been the topic of some debate. Generally speaking, the strength of evidence varies according to how one reviews the data (eg, random assignment, use of treatment manuals). For example, if evaluation criteria place an emphasis on RCTs, then ABA treatments might be deemed to have low-to-moderate evidence.[23,24] By contrast, reviews that include studies that use within-subject experimental analyses are more likely to conclude that there is strong evidence supporting ABA treatment.[21,25] As previously noted, however, the lack of RCTs of ABA treatments has limited the conclusions that can be drawn about the efficacy of these approaches[23] and has led to calls for additional RCTs in this area.[26] In addition, the extant ABA treatment literature tends to focus on broad skills among younger children (eg, imitation behavior among toddlers with ASD)[27] or specific behaviors among older individuals (eg, aggression among adolescents with ASD and intellectual disability). Nevertheless, like all sciences, ABA is a continually evolving field in terms of breadth of approaches used[28] and problems addressed.[29] In fact, in the years since Lovaas et al[30] described the outcomes for their first cohort of children with ASD who received EIBI, several ABA treatment approaches have been developed as alternatives or adjuncts to the Lovaas model.

One of the first alternative forms of ABA treatment for ASD was the natural language paradigm (NLP), one of the first of the naturalistic language training strategies.[31] NLP is implemented in a naturalistic, play-based context. The therapist delivers reinforcement for all verbal attempts, even those that are less accurate than those the child has previously displayed. The therapist and the child take turns with the toys during the treatment, thus allowing the therapist to model appropriate toy play and relevant speech in a