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REVIEW ARTICLE

Applied behavior analytic interventions for children with autism: A description and review of treatment research

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BACKGROUND: Autism is a disorder characterized by pervasive delays in the development of language and socialization, and the presence of stereotyped, repetitive behaviors or nonfunctional interests. Although a multitude of treatments for autism exist, very few have been the subject of scientific research. The only treatment that has been supported by substantial empirical research is treatment based on applied behavior analysis (ABA).

METHODS: This article describes components of comprehensive ABA treatment programs, reviews research on effectiveness, and discusses issues related to collaboration between ABA and psychiatry.

RESULTS: ABA has been supported by several hundred single case experiments and an increasing number of between-groups studies. Comprehensive ABA treatment programs are comprised of multiple intervention procedures, such as discrete trial instruction and natural environment training, and are founded on basic principles of learning and motivation, such as positive reinforcement, extinction, stimulus control, and generalization. Clinicians in the fields of ABA and psychiatry have similar goals regarding client outcome, and several ABA measurement and analysis procedures produce information that may be useful to psychiatrists.

CONCLUSIONS: ABA treatment programs for individuals with autism are supported by a significant amount of scientific evidence and are therefore recommended for use. Patient care would likely benefit from a greater degree of collaboration between practitioners in the fields of ABA and psychiatry.

KEYWORDS: autism, ASD, applied behavior analysis, ABA, EIBI

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INTRODUCTION

Autism spectrum disorders (ASD) has become the commonly used term for all diagnoses falling within the pervasive developmental disorders, including autistic disorder (299.00), pervasive developmental disorder not otherwise specified (PDD NOS) (299.80), Asperger's disorder (299.80), Rhett's disorder (299.80), and childhood disintegrative disorder (299.10). ASD are characterized by deficits in 2 or more areas of functioning, including impaired language development, impaired social development, and the presence of excessive and stereotyped repetitive behaviors or interests. Prevalence estimates of ASD have increased dramatically in recent years and may be due in part to an actual increase in the occurrence of this disorder as well as greater awareness of the disorder among clinicians. The most recent estimate of the prevalence of autism among children in the United States, released by the Centers for Disease Control and Prevention based on 2002 data, is approximately 1 in 150.[1] Accordingly, greater public attention has been directed toward ASD in recent years, and significant public funds have been allocated toward research. However, parent groups commonly decry the lack of research and practical information on effective treatment.

Numerous treatments for ASD exist,[2] all of which are enthusiastically supported by those who developed them and by parents who desperately cling to the hope that something will cure their children. Unfortunately, the vast majority of these treatments have not been subjected to sound scientific research. The single treatment approach garnering substantial scientific support involves intervention based on the principles and procedures of applied behavior analysis (ABA). First applied to autism in the 1960s, ABA has since been the subject of several hundred treatment studies published in peer-reviewed journals.[3] The substantial body of research supporting ABA for children with autism has led several independent entities to acknowledge ABA and endorse its use for children with autism, including the US Surgeon General,[4] the New York State Department of Health,[5] the National Academy of Sciences,[6] and the American Academy of Pediatrics.[7] The impact of such endorsements is evidenced by public policy changes such as formal state funding being allocated to autism treatment and state-level legislative decisions mandating insurance coverage for ABA treatment (eg, "Steven's Law," Arizona House Bill 2487).

APA is the application of principles of learning and motivation to the solution of problems of social significance. The treatment of autism is perhaps the discipline to which ABA has been applied most prolifically. Three comprehensive reviews of autism treatment research have been published recently,[7-9] and it is not the purpose of this article to duplicate them. Rather than reviewing all autism treatment research, this article focuses on describing and reviewing common ABA clinical practices, as well as the results of research on ABA treatment. In what follows, we describe ABA as it is applied to ASD, review the research that supports its use, and describe a productive model for the collaboration of ABA and psychiatry. In so doing, we will describe components of ABA treatment programs for younger and older children and will make the case that both ABA providers and psychiatrists would benefit from a more collaborative relationship than is common at the present time.

Components of early intensive behavioral intervention programs

Early intensive behavioral intervention (EIBI) consists of the application of ABA principles and procedures for the comprehensive habilitation of young children with ASD. Treatment is generally initiated as early as possible, is implemented intensively (eg, up to 40 hours per week), and attempts to address all impaired areas of functioning. Below, we review the primary components of EIBI treatment programs. In addition, the reader is referred to several treatment manuals for a more thorough description of procedural details.[10-13]

Basic principles. The procedures implemented in EIBI programs were developed over the last 40 or more years of research in ABA. These procedures are all founded on behavioral principles of learning and motivation, consisting of reinforcement, extinction, stimulus control, and generalization.[14] A basic assumption of behavioral psychology is that everything that people do, be it linguistic, social, adaptive, or maladaptive, can be considered behavior. The basic learning principle at the core of ABA is the notion that the consequences of a behavior can either strengthen or weaken it. Behavior that is followed by the presentation of desirable consequences or the removal of aversive consequences will be strengthened (this is referred to as *reinforcement*) whereas behavior that is followed by the presentation of aversive consequences or the removal of desirable consequences will be weakened. By systematically presenting

such consequences when a behavior occurs, we arrange the environment such that the behavior increases or decreases in the future. Terminating reinforcement for a behavior reduces the future probability of that behavior; this principle is referred to as *extinction.* Moreover, the contiguous occurrence of reinforcers in the presence of other stimuli results in those stimuli taking on the positive properties of the initial reinforcer, thereby becoming conditioned to produce the same increase in behavior initially observed. This process is referred to as *conditioned reinforcement*. Further, when a particular behavior is reinforced in the presence of a particular antecedent stimulus, and not in its absence, the behavior begins to occur only in the presence of that stimulus and not in its absence. This process is known as *stimulus control.* For example, when one is driving, one stops at a red light because in the presence of a red light, the behavior of stopping produces the desirable consequences of avoiding a vehicle collision and a traffic citation. That is, due to a history of receiving reinforcement for a particular behavior in the presence of a particular stimulus, that stimulus now signals to the person behaving which behaviors will result in which particular reinforcers. Finally, the effects of reinforcing a behavior in the presence of one stimulus spread to other stimuli, such that if one learns how to do something in one context, one will be able to do it in other contexts as well. The spreading of the effects of learning from one circumstance to another is called *generalization* and applies to all stimuli that form the contextual environment within which a behavior occurs, whether it be changes in setting, the people present, or the time of day during which the behavior occurs.

Procedures. The principles of reinforcement, extinction, stimulus control, and generalization are applied in the 4 teaching procedures, known as (1) prompting, (2) fading, (3) shaping, and (4) chaining.[15] *Prompting* involves the presentation of cues or assistance in order to make a behavior occur that otherwise would not. For example, when teaching a child with autism to ask for his favorite toy car, one might give the prompt "Say car," so that the child's behavior of saying "car" might then occur, thereby giving the therapist the opportunity to reinforce the child's behavior of saying "car" by giving him his favorite car. Prompts are universally considered a temporary measure and are only used so that a particular behavior can be made to occur and then be reinforced.

Almost immediately, *fading* must be incorporated. Fading refers to the systematic removal of a prompt, such that the desired behavior or skill continues to occur in its absence. Prompts can be faded in a number of ways, including by intensity, immediacy, etc.

Shaping is a procedure that involves reinforcing successive approximations to a desired behavior. For example, if a child is not able to imitate the full word "car," then one might start by reinforcing the first approximation, simply the sound "K." Once the child is proficient with this skill, one might proceed by prompting and reinforcing "kah," and finally "car."

Chaining is a procedure used to teach a long sequence of behaviors that might be impossible for a child with ASD to learn all at once, but where acquisition is possible when the entire sequence is broken down into small behaviors; these behaviors are then prompted and reinforced, thereby creating a "chain" of behaviors. For example, when attempting to teach a child how to prepare a snack, one might start by teaching the child to verbally identify which foods she needs to get, then get them out of the refrigerator, then place them on the counter, then prepare the snack, then clean up, etc, until each step in the sequence is learned.

Teaching formats. The principles and procedures used above must then be put together into overall formats for teaching. Early EIBI programs were primarily comprised of discrete trial training (DTT),[11,16] and perhaps for this reason, some currently confuse DTT with EIBI, although the former is simply one of many teaching formats within the latter. DTT is a structured teaching format, wherein multiple discrete opportunities, or "discrete trials," are presented across the day. A discrete trial consists of the therapist presenting an instruction, the child responding in some way, and the therapist then responding by presenting a consequence to him or her. For example, the instruction might be "What is your name?" The child then responds correctly, and the therapist responds by giving the child a reinforcer. If the child responds incorrectly, a reinforcer is not delivered and the therapist typically presents some kind of correction procedure, such as modeling the correct response and then initiating another discrete trial. One strength of DTT is that, by definition, it involves a large number of trials presented in a short amount of time, thereby ensuring a large number of learning opportunities. A potential limitation of DTT is that skills learned in DTT may not generalize readily to less structured settings and that some children may have negative reactions

to the structure and rigor of the training format. Some initial research has supported these concerns[17] but more research is needed. In any case, virtually all modern comprehensive EIBI programs supplement DTT with less structured teaching formats, such as those described below.[12]

In contrast to the highly structured, contrived teaching environment common in DTT, natural environment training (NET) is designed to mimic typical adult-child interactions and maximize naturally occurring learning opportunities. As the name implies, NET focuses on teaching skills in an environment and format that more closely resemble the typical daily activities that a young child may encounter. In addition to the loosely structured format of instruction, NET differs from DTT in that learning trials are initiated by the learner, rather than the therapist.[12] For example, the learning trial is initiated when the child indicates, by reaching, pointing, or vocalizing, that he or she desires something. The therapist recognizes the learning opportunity and responds by prompting a desired behavior and then gives the child what she wants. Under the larger umbrella of NET are several specific approaches such as incidental teaching,[18] milieu teaching, and pivotal response training (see Kaiser and Trent[19] for a review). The strengths of NET are that it may lead to enhanced generalization of skills and that some children may have fewer negative reactions to the less structured format.[17]

Although DTT and NET comprise the core of comprehensive EIBI programs, numerous other ABA procedures have been researched extensively and commonly put into practice in EIBI programs. An exhaustive treatment of these procedures is beyond the scope of this article, but the reader is encouraged to seek out additional information on video-modeling,[20] script-fading,[21] picture activity schedules,[22] and peer-mediated social skills training procedures.[23]

Challenging behaviors. Repetitive behavior (eg, stereotypies, "self-stimulatory" behavior) is inherent in ASD diagnoses. However, other challenging behaviors, such as self-injury, aggression, property destruction, and tantrums, are also quite common, likely often due to delays in communication skills. All challenging behaviors may impede learning and everyday functioning, so effectively treating them is an integral component of top-quality EIBI programs.[12] The ABA approach to such behaviors is to analyze why they occur by identifying the ongoing sources of reinforcement that the behaviors normally produce. Such sources of inadvertent reinforcement from caregivers include attention, escape from nonpreferred activities, and access to preferred items, foods, or activities. In many cases, a child who cannot communicate may have tantrums or act out in order to have his or her needs met. After identifying the ongoing source of reinforcement for each challenging behavior, EIBI programs treat the behavior by teaching the child an alternative, more appropriate means of attaining the reinforcement and by no longer allowing access to the reinforcement when the challenging behavior occurs. For example, instead of allowing a child to escape instructional demands when he has a tantrum, the child will be taught to ask for a break or ask for help.

Scope of intervention. EIBI programs are comprehensive in nature. That is, the programs are explicitly designed to address every identifiable area of deficit. Put simply, if there is something that a child should know how to do for his or her age, a comprehensive EIBI program should analyze that skill as a teachable behavior and teach it. General curriculum areas that are addressed are language, social skills, play skills, motor skills, pre-academic and academic skills, and independent living skills.

Research on early intensive behavioral intervention

In the past 20 years, 7 long-term, large-scale controlled studies have demonstrated that children who receive more than 25 hours per week of ABA for more than 1 year make tremendous gains, with some participants achieving functioning within the average range for their age.[8] Historically, EIBI research has been criticized for its small sample sizes, lack of randomized control trials, and failure to include procedural integrity measures. However, the growing collection of well-designed research studies, particularly in the last few years, has made progress in addressing these concerns. In a recent critical review, Rogers and Vismara[9] applied criteria for empirically validated treatments to this literature and concluded that EIBI meets criteria for a "well-established" treatment. As the details of the methodological rigor of these studies have been reviewed recently elsewhere,[8,9] we will eschew doing so and instead focus on a description of the treatment provided and the major findings of the studies.

The first controlled study to evaluate long-term EIBI for children with autism was conducted in 1987 by Ivar

Lovaas at the University of California, Los Angeles.[16] This study compared outcomes for a group of children who received intensive (40 hours per week) EIBI to the outcome of children who received low-intensity (ie, 10 hours per week) behavioral intervention. All children received their respective treatments for 2 or more years. Assignment to groups was not random; rather, it was based on availability of staff to provide the intensive ABA therapy. However, statistical analyses showed that the groups did not vary significantly on any measures at intake. Results of the study indicated that 47% of the children in the EIBI group achieved a normal IQ and were succeeding in first grade placement in regular education classrooms, without specialized supports of any kind (ie, no curriculum modifications, no one-to-one aid, etc). Children in the control groups, however, made much smaller gains, with only 2% of children achieving normal educational and intellectual functioning. In 1993, McEachin, Smith, and Lovaas[24] published a follow-up study, wherein participants in the intensive ABA group were reevaluated at a mean age of 11.5 years. Eight of the 9 participants had maintained intellectual functioning in the normal range, and all 9 scored in the average range across all scales on the Personality Inventory for Children.

Subsequent studies on EIBI have produced similar results. Sallows and Graupner[25] found that 48% of children who had received 4 years of EIBI scored in the average range on measures of IQ, with 34% succeeding in regular education with no specialized supports, and 34% scored as non-ASD according to results of the Autism Diagnostic Interview-Revised (ADI-R). Cohen et al[26] studied the effects of 3 years of EIBI on young children with autism and found that children receiving EIBI outperformed controls on measures of intelligence and adaptive behavior. This study indicated that 28% of participants were successfully transitioned to regular education placements, whereas only 4% of controls were able to do so. Eikeseth et al[27] extended previous research by evaluating intensive ABA treatment for slightly older children with autism. Whereas the previous studies included children under the age of 60 months, this study analyzed the effects of intensive ABA on children who were 4 to 7 years old at intake. The ABA group attained significant increases in IQ and adaptive functioning, when compared with a control group who received standard "eclectic" special education services for the same number of hours per week and for the same duration. Remington and colleagues[28] compared the effects of 2 years of EIBI to "treatment as usual" for preschool age children in the United Kingdom and found substantially greater gains in intelligence, language, daily living skills, and social behavior for the children who received EIBI.

Perry and colleagues[29] evaluated the effectiveness of a government-funded, province-wide EIBI program for children with ASD and found that, of 332 children who received treatment, 71% achieved gains of some sort. According to results of the Childhood Autism Rating Scale (CARS), 41% of the children who were assessed to be in the mild/moderate autism range pretreatment scored in the non-ASD range posttreatment. Children who scored in the severe autism range at intake, according to the CARS, also made substantial gains, with 59% scoring in the mild/moderate range and 15% scoring in the non-ASD range posttreatment. It should be noted that this study lacked a control group of any kind and that the results are somewhat less robust than those found by smaller-scale studies. However, the results are particularly encouraging because treatment was provided by a large number of disparate ABA providers and was not prescribed and controlled by a central university-based program. Therefore, the Perry et al[29] results lend encouraging evidence for the real-life effectiveness of EIBI on children with autism.

Taken together, the studies summarized above demonstrate clearly that EIBI produces substantial gains in children with ASD; however, several questions remain. Two areas of concern stated in the American Academy of Child and Adolescent Psychiatry's *Practice Parameters for the Assessment and Treatment of Children, Adolescents, and Adults With Autism and Other Pervasive Developmental Disorders*[30] were the issues of the intensity and duration of treatment. Although more research is needed to address these concerns, several studies have been published since the publication of the *Practice Parameters*, and the results are discussed below.

Weekly intensity of treatment. The required weekly number of hours (often referred to as "intensity") of EIBI is an often-debated topic. However, the results of research are fairly clear. The initial study by Lovaas[16] included a group who received low-intensity ABA (approximately 10 hours per week), and the results demonstrated significantly smaller gains than the high-intensity (40 hours per week) group. Eldevik et al[31] conducted a study wherein children with autism received low-intensity ABA therapy (approximately 12 hours per week) for 2 years. These participants achieved statistically significant gains when

compared with a control group, but the gains were considerably lower than those found in studies of high-intensity ABA. Reed and colleagues[32] descriptively compared 9-month outcomes of a group of children who received a mean of 30 hours per week of ABA therapy with a group of children who received a mean of 12 hours of ABA therapy per week and found that the high-intensity group achieved significantly greater gains. Smith et al[33] evaluated the effects of 25 hours per week of ABA therapy for 2 years. Results indicated that the ABA group achieved gains that were statistically significant when compared to a control group, but which were considerably lower than those produced by studies of high-intensity ABA. Taken together, the studies summarized above indicate that the mere provision of EIBI is not sufficient to produce optimal outcomes, but rather that EIBI must be implemented at sufficient intensity (ie, 30 to 40 hours per week).

Total duration of treatment. The total duration of treatment (ie, years, months, etc.) required to produce optimal gains for children with autism is also commonly debated. However, several research studies suggest that treatment for 2 or more years is likely needed to produce optimal results. Howard and colleagues[34] compared 14 months of intensive ABA therapy to eclectic therapy of the same duration for young children with autism. Results showed that the ABA group made statistically significant gains when compared to the control group but that the gains were less than those seen in studies that evaluated intensive ABA for 2 or more years (eg, see Lovaas,[16] Sallows and Graupner,[25] and Cohen et al[26]). Although not yet published, follow-up data from the Howard et al[34] study show that the difference in outcomes between the EIBI group and control group continued to increase over the second year of exposure to EIBI.[35] Eikeseth and colleagues[36] evaluated the effects of intensive ABA therapy for 1 year and found significant results, but these were still lower than studies evaluating longer-term ABA therapy. When follow-up data from the same study were later published, the results indicated that children in the behavioral intervention group continued to progress significantly during their second year of treatment.[37]

Reed et al[32] found that 9 months of intensive ABA produced significant but lesser gains than those of studies evaluating long-term ABA. Sallows and Graupner[25] reported outcome data after the first year of treatment (as opposed to the full duration, equaling 4 years) which demonstrated that children receiving EIBI made substantial gains after 1 year when compared with controls, but that participants continued to achieve further gains in the subsequent 3 years. Sheinkopf and Siegel[37] evaluated ABA therapy that was both lower in intensity (approximately 20 hours per week) and shorter in duration (approximately 15 months) and found that children again achieved statistically significant gains in IQ when compared with controls, but that the gains were smaller than those found in studies which implemented ABA for 2 or more years. Zachor et al[38] compared outcomes of children with autism who received intensive ABA for 1 year with those who received eclectic developmental intervention and found that 4 of 19 (21%) children who received intensive ABA no longer qualified for an ASD diagnosis according to the ADOS, whereas all children in the eclectic developmental group still did. Although these results are robust, the studies summarized earlier that implemented EIBI for a longer duration found a higher percentage of participants scored in the nonimpaired range posttreatment. The studies described above, particularly when contrasted with existing studies on longer-term EIBI, appear to provide significant evidence that EIBI for children with autism should be provided for 2 or more years in order to obtain optimal therapeutic results.

Predictors of treatment outcome. Although EIBI has been demonstrated to produce significant gains for children with ASD, the magnitude of response to treatment appears to vary significantly among children. This common result of EIBI outcome research has highlighted the need for research on variables that predict outcome. Initial attempts have been made to identify the characteristics of children who obtain the best outcomes from EIBI. For example, Bono and colleagues[39] found that gains from intervention were correlated with participants' initial language skills and their ability to respond to joint attention initiations from others. Sigman and McGovern[40] found that functional play skills and frequency of requesting behaviors predicted treatment outcome. Sallows and Graupner[25] identified a relationship between treatment outcomes and pretreatment skills in the areas of imitation, language, and socialization. Szatmari and colleagues[41] also found that early language development was predictive of outcome, as well as nonverbal cognitive abilities. Although these studies have begun to examine the link between a child's individual characteristics and his or her response to intervention, the heterogeneity of their results also illustrates the current difficulty of predicting which children will benefit most from EIBI.

Far more important than merely predicting out-

come would be customizing treatment based on predictors in order to bring about more favorable outcomes. For example, if imitation skills at intake predict outcome, then perhaps modifying EIBI programs for children with this profile by focusing more heavily on imitation than is typically done could produce more optimal outcomes. To the extent that predictor variables map onto skills or behaviors that can be directly addressed during early stages of behavioral intervention (as opposed to purely organic variables, which cannot), it seems at least plausible that the effectiveness of EIBI could be enhanced. Much research is conducted on the details of EIBI, but no study has been published to date that implemented a specific enhancement of EIBI for a particular participant characteristic and then assessed long-term outcome in order to evaluate whether improved results were produced. Given the known effectiveness of EIBI and the known variability in response to treatment, more research on how to improve EIBI in order to improve outcomes for all children is clearly needed.

Clinical recommendations. Based on the available research on the effectiveness of EIBI, children under age 7 who have autism should receive 30 to 40 hours per week of one-to-one behavioral intervention for a minimum of 2 years. EIBI programs should be comprehensive in that they address all areas of deficit for each individual child; they should address all challenging behaviors exhibited by the child; they should be based on behavioral principles of learning and motivation; and they should contain both DTT and NET teaching components.

Research on ABA for older children and adolescents with autism

A commonly held misconception is that ABA is primarily for young children with autism. Research and practice on EIBI currently receives the most public attention, but a very substantial amount of research has been conducted on ABA treatment for older children and adolescents with autism. It is likely that the reason why EIBI has garnered the majority of attention is that the gains that have been demonstrated by EIBI research are far more dramatic than those demonstrated by research on ABA for older children. Nevertheless, hundreds of studies have been published in peer-reviewed journals on the application of ABA procedures to improving the functioning of older children and adolescents with ASD. Several groups are currently in the process of reviewing all such research (eg, Association for Science in Autism Treatment), but none have yet published their results. A review of all relevant literature is beyond the scope of this article, but we will briefly review the general characteristics described in the literature as well as some specific examples that may be representative.

Scope and duration. The scope and duration of research studies on ABA for older children with ASD are significantly narrower and shorter than those of EIBI research. Whereas the goal of long-term EIBI studies has been to remediate all skill deficits displayed by participants, the goal of most research on ABA for older children with autism has been to identify and remediate particular deficits in a short period of time. For example, goals of ABA research for older children might include teaching one particular skill of independent living, or reducing one particular challenging behavior by replacing it with functional communication. Therefore, most of the studies we describe below address a small number of behaviors for a short period of time (eg, 1 or 2 months). As such, these studies address individual components of what might be considered a comprehensive program, but not the outcome of a comprehensive treatment program as a whole.

Research design. The research designs used in research on ABA for older children with autism match the purpose and goals of the research, that is, to identify and improve particular behaviors and skills in particular individuals. Therefore, single case experimental designs dominate this literature. Single case experimental designs typically have each individual participant as his or her own control and therefore expose him or her to alternating conditions of either the treatment or one or more controls. Rather than replicating the treatment effect across multiple individuals within a group, as traditional group designs do, single case experimental designs replicate the treatment effect at multiple different experimenter-dictated times with each participant. Although single case experimental designs have not traditionally been accepted within the medical research community, they have a long and fruitful tradition within behavior science and their utility has led to independent groups acknowledging their role within the process of identifying empirically validated treatments.[42]

Clinical focuses of intervention. Virtually all areas of human functioning have been affected in a positive way in research on ABA for older children with autism. Below, we describe a small sample of research on treatment in several broad areas of functioning.

LANGUAGE. A hallmark of ABA interventions is a

focus on establishing functional, independent language and communication skills. Research has demonstrated that the basic components of ABA intervention (described earlier in this article) can be combined and used to improve language of all sorts in children of all ages. Types of language which have been intervened upon run the gamut of human communication, from simple nonvocal requesting via picture-exchange[43] and naming of familiar objects via sign language,[44] to improving performance at writing simple essays.[45]

ACADEMICS. ABA procedures have been used to teach a variety of academic and pre-academic skills to individuals with ASD. For example, performance on basic math problems has been improved,[46] ABA approaches to teaching reading comprehension have been successful,[47] and children with autism have been taught knowledge of geography.[48]

SOCIAL FUNCTIONING. Research has demonstrated ABA procedures to be effective in treating the full range of play and social skills, from basic "cause-and-effect" play, to relatively complex interactive play (See Matson et al[23] for a review). Initial forays into teaching social perspective taking or "theory of mind" using ABA procedures have also been successful.[49,50]

INDEPENDENT LIVING SKILLS. ABA procedures have been applied to teaching older children and adolescents with ASD a variety of independent living skills, for example, how to find and access preferred Internet sites without assistance,[51] table-setting skills,[52] and how to seek assistance when lost.[53]

VOCATIONAL SKILLS. ABA procedures have been used to assess and establish vocational skills in individuals with ASD. Of particular note is the application of ABA procedures for assessing preference and embedding choice within the vocational setting, thereby ensuring the greatest possible degree of independence and self-determination.[54]

CHALLENGING BEHAVIORS. Research has indicated that ABA procedures have been particularly successful in assessing and treating challenging behaviors in persons with ASD. The general approach for older children is identical to that for young children—to identify why a challenging behavior occurs and to teach the individual an alternative, appropriate means to communicate to have their needs met. Such an approach is referred to as "functional communication training" and has been the subject of a substantial amount of treatment research.[55]

FEEDING DISORDERS. A significant amount of research has demonstrated the effectiveness of ABA procedures for treating pediatric feeding disorders in persons with developmental disabilities. Studies have been published on treating food selectivity,[56] increasing swallowing of previously refused foods,[57] and treating adipsia[58] in older children and adolescents with ASD.

Characteristics of ABA programs for older children and adolescents

Just as the scope and duration of research studies on ABA for older children with ASD are narrower and shorter-term than those of EIBI research, service provision programs may often have a narrower focus and emphasize high-priority, short-term goals. Such programs often function on a consultative model, wherein the day-to-day care providers for older children with ASD contact an ABA provider for help when they are at a loss as to how to solve particular problems. In general, the more severe the problem, the more likely a care provider may be to seek outside help from an ABA provider. Such problems include, but are not limited to, particularly destructive behavior, such as aggression, property destruction, elopement, or self-injury. An ABA provider may also be consulted when a marked inability to produce acquisition of particularly pivotal skills occurs, eg, when an individual has not acquired any functional form of communication, any degree of toileting or other "self-help" skills, or presents with a significant feeding disorder, such as food refusal or food selectivity.

Whatever the reason for the initial contact between the older child with ASD and the ABA service provider, the general process of assessment and treatment contains the same basic elements. First, an individual's team is convened, either in person or by phone, and goals are agreed upon. Good goals define the particular behaviors that are problematic and the particular skills in need of enhancement, as well as setting challenging but achievable benchmarks for assessing whether the proposed intervention helps achieve the goal. Next, the ABA professional conducts a functional assessment to determine the nature of the current problem and likely sources of motivation relevant to the person being treated. After the functional assessment has been completed, an intervention plan is developed. The intervention plan uses the basic principles and procedures of ABA to address the unique strengths, deficits, and functional properties of the person's behavior. All caregivers who are then expected to implement the intervention are trained and

provided with support such that they can implement it correctly. Quantitative data are then collected on the status of adaptive and maladaptive behaviors, so that the effects of the intervention can be closely evaluated on an ongoing basis. Small, systematic changes are made to the intervention, if needed, until the goals constructed at the outset are achieved. Contingencies are then planned to maintain the progress made, and environmental supports are put in place to ensure it.

Clinical recommendations. The lack of research on the optimal weekly intensity, overall duration, and scope of intervention for older children and adolescents with autism precludes making any definitive recommendations along these lines. However, ample research has demonstrated that targeted interventions for particular skill deficits and challenging behaviors can be effective when each intervention is implemented for several hours per week. There is no logical reason to believe that several such interventions could not be combined at any given time to address a larger variety of issues across a larger portion of an individual's day. Put simply, there is every reason to believe that the more hours an expert ABA supervisor spends analyzing and programming for particular challenging behaviors and skill deficits, and the more hours ABA interventionists are available to work directly with the client and implement his or her intervention programs, the more challenges can be met during any given week.

Collaboration between psychiatry and applied behavior analysis

The American Academy of Child and Adolescent Psychiatry (AACAP) has articulated well the role that child and adolescent psychiatrists play in collaboration with other healthcare providers. In describing the integral nature of collaborations, they state:

> *Collaborations are required in all treatment settings, at all levels of care, both acute crisis and long-term encounters. This is especially true in special populations such as those with complex co-morbid conditions, including developmental disabilities, substance abuse problems, juvenile justice and/or child welfare involvement.*

We wholeheartedly agree with this assessment. Given that one of the common "other healthcare providers" are ABA providers, further discussion of specific ways in which collaboration may be accomplished would do much to help realize this goal.

Not all collaborative efforts are successful or helpful. It is reasonable to assume that many practitioners from all sides of the collaborative process are often frustrated with the interaction. This frustration is often the result of differing perspectives. However, it is specifically the difference in perspectives and the training and knowledge that come with it that make the collaborative process meaningful. In our experience, the collaborative process becomes much less frustrating and much more beneficial to the child with autism if a focus is made on the common goal of improved care for the child with autism and the attainment of measurable progress toward this goal.

The goals of ABA and psychiatry are clearly in line with one another. The goal of the ABA provider, at the level of the individual child with autism, is to analyze the child's current status and to make clinical judgments and recommendations that will enhance the quality of the child's life—clearly the goal of the psychiatrist as well. Put more specifically, both the ABA provider and the psychiatrist strive to change socially meaningful behaviors to a clinically significant degree. Clinicians from both disciplines would like to see challenging behaviors decrease and adaptive skills improve. We propose that the individual child will be best served if there is frequent communication between ABA providers and psychiatrists working with the same child at the same time. However, simply increasing communication is not enough—what is needed is active collaboration in our treatment efforts. In what follows, we briefly describe some pitfalls and recommendations for the nature of that relationship.

Providers of ABA services collect objective measures of many of the behaviors that would be of interest to psychiatrists. For example, if a family is seeking psychiatric help for their child who exhibits self-injurious behavior, it is highly likely that the child's ABA provider is already collecting data on how often that behavior occurs. ABA providers often keep track of the frequency of both adaptive and maladaptive behaviors, record the duration of such behaviors each time they occur, or record some estimate of the percentage of time periods (eg, hours, days, etc) in which such behaviors have occurred. Psychiatrists may find these data to be a useful tool for assessing the ongoing effects of pharmacologic interventions, and ABA providers would very likely find psychiatrists' input on such matters highly useful. However, without explicit efforts at communication on both sides, it is likely that psychiatrists are not aware of the existence of such data, and/or that ABA providers

may not be aware that they are not providing such data to a psychiatrist who would appreciate having it.

Since both psychiatrists and ABA providers make changes that they hope will affect patient behavior, clear communication and coordination are critical. A consequence of a lack of such communication is something akin to a confounding variable in an experiment. Specifically, if an ABA provider makes a significant change to a behavior intervention plan at the same time that a psychiatrist makes a significant change to a medication regimen, and a change in behavior is observed, it will be impossible to determine which change in treatment was responsible for the change in behavior, or if the combination of behavioral and pharmacologic interventions produced the effect. An opportunity to discover an important treatment finding for that patient would have been missed. In the best-case scenario, the ABA provider and psychiatrist would be aware of this confound and would work together to resolve it. However, a much worse scenario is likely far more common, that is, that the ABA provider and psychiatrist are unaware of one another's efforts and, therefore, can only conclude that their own intervention was responsible for behavior change. In cases in which the behavior change is positive, then unneeded behavioral or pharmacologic treatment components (which can be costly both in time and financial resources) will likely continue. In cases in which the behavior change is negative, both clinicians may be apt to recommend the removal of their treatment recommendations, one of which may very well have been crucial for the patient's well-being.

Given that collaboration and communication between ABA providers and psychiatrists may currently be somewhat less common than may be desired, one must assume that scenarios such as those described above are not at all uncommon. Fortunately, there is a simple, low-effort, relatively low-cost solution: frequent communication between ABA providers and psychiatrists. Whenever possible, this should occur during in-person interdisciplinary team meetings. In the vast majority of cases, however, such in-person meetings are rare or nonexistent, largely due to logistical and monetary constraints. However, frequent communication between both disciplines via telephone and e-mail should not be difficult. Ideally, ABA providers and psychiatrists should present their findings to one another, assess the patient's current status, and discuss plans for future changes at regular intervals. At a minimum, clinicians from both disciplines should contact one another and exchange information before making any major treatment changes.

A benefit to the model in which ABA services are usually provided is that most behavior data are collected by someone other than the treatment supervisor. Therefore, it is possible for ABA supervisors and psychiatrists to collaborate closely and strategically on the course of their combined interventions, while keeping the direct-care ABA staff blind to changes in medication. Blinding data collectors should result in behavior data that is less likely to be compromised by their expectations or biases. A recent study by Crossland and colleagues[59] provided a demonstration of an effective collaboration in the cases of 2 individuals with autism who displayed destructive behavior. The investigators systematically implemented and removed risperidone treatment, while simultaneously continuing to conduct behavioral observations and assessments, all the while keeping behavior data collectors blind to whether participants were experiencing medication or placebo phases. The results demonstrated that risperidone differentially affected destructive behaviors that were motivated by escape from task demands vs attention from caregivers and that aggression and self-injurious behaviors were not affected equally. Furthermore, and not surprisingly, risperidone produced differential effects across participants.

Another fine example of the evaluation of the interaction between behavioral and pharmacologic interventions is that provided by Dicesare and colleagues.[60] In their study, they reported the results of a functional analysis of the disruptive behavior of a young man with developmental disabilities. The results of the functional analysis were inconsistent, except when the presence or absence of methylphenidate was taken into account, in which case the functional analysis clearly demonstrated that the behavior was motivated by attention seeking. The knowledge produced by these results would be critical for ABA providers because it would elucidate the source of motivation for challenging behavior, and would therefore inform the provider and the family how to decrease that motivation (eg, provide attention when the young man was not engaging in disruption, teach him how to ask for attention, etc.). These data would also be critical for the young man's psychiatrist because they would provide objective evidence that methylphenidate had a positive impact on the behavior of concern.

The level of nuance and detail achieved by the 2 studies described above could not be achieved without close

collaboration between disciplines, and in both cases, crucial implications for treatment were obtainable only as a result of this collaboration. It is not unreasonable to assume that understanding complex drug-environment interactions on a case-by-case basis is crucial for maintaining the highest standard of care for patients. Since it is the psychiatrist's job to manipulate drugs and the behaviorist's job to manipulate the environment, both must maintain effective 2-way communication with one another if confusion is to be avoided and effective treatment is to be achieved.

CONCLUSION

Substantial research documents the effectiveness of ABA treatments for autism. The most robust gains have been demonstrated when ABA is provided according to the EIBI model: 30 to 40 hours per week of one-to-one ABA intervention, for 2 or more years, beginning before age 5. Although it is highly recommended that individuals with autism access EIBI, ABA has also been demonstrated to be effective in addressing particular challenging behaviors and skill deficits in older children and adolescents. Finally, a unique opportunity exists for collaboration between ABA and psychiatry, an opportunity that has largely been squandered until now. Given the overlapping goals of ABA and psychiatry and the utility of ongoing behavior data collection, it is clear that collaboration in the form of frequent, open communication between ABA providers and psychiatrists can only result in improvements in patient care. ■

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