Behavioral Treatments in Autism Spectrum Disorder: What Do We Know?

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Abstract

Although there are a large and growing number of scientifically questionable treatments available for children with autism spectrum disorder (ASD), intervention programs applying the scientific teaching principles of applied behavior analysis (ABA) have been identified as the treatment of choice. The following article provides a selective review of ABA intervention approaches, some of which are designed as comprehensive programs that aim to address all developmental areas of need, whereas others are skills based or directed toward a more circumscribed, specific set of goals. However, both types of approaches have been shown to be effective in improving communication, social skills, and management of problem behavior for children with ASD. Implications of these findings are discussed in relation to critical areas of research that have yet to be fully explored.

Contents

INTRODUCTION

Autism spectrum disorder (ASD) is a group of neurobiological disorders with long-term implications for the individuals concerned, their families, and for the provision of education and habilitative services. In recent years, there has been a dramatic increase in the number of individuals, of all ages and all levels of ability and severity, seeking treatment services for autism (Kogan et al. 2008). It is now widely acknowledged that the forms of treatment with the most empirical validation for effectiveness with individuals with ASD are those treatments based on a behavioral model (Natl. Res. Counc. 2001). A defining characteristic of these treatments is their foundation in the experimental analysis of behavior, which is a science devoted to understanding the laws by which environmental events influence and change behavior. The clinically applied field from this science is known as applied behavior analysis (ABA), and the development of the behavioral treatments of autism is largely the result of this field of science (Schreibman 2000).

Autism spectrum disorder (ASD): a group of neurobiological disorders characterized by impaired social interaction and communication and by restricted and repetitive behavior

Applied behavior analysis (ABA): an applied science devoted to understanding the laws by which the environment affects behavior in order to address socially significant problems for individuals with disabilities

ABA requires careful assessment of how environmental events interact to influence an individual's behavior. The assessment consists of contextual factors such as the setting in which a behavior occurs; motivational variables such as the need to attain something; antecedent events leading to the occurrence of a behavior, such as a request to do something or a question from another person; and consequences or events following the behavior that dictate whether the behavior is likely to occur again. A detailed assessment of how the environment and the individual's behavior interact is crucial because the information resulting from this assessment leads to the design, implementation, and additional evaluation of environmental interventions intended to change behaviors. For individuals with ASD, these behaviors typically include language and communication, social and play skills, cognitive and academic skills, motor skills, independent living skills, and problem behavior (Smith et al. 2007). Progress in achieving the desired behavior change is typically determined by direct observations that occur on multiple occasions with the same individual over time. An equally important measurement is the acceptability of the interventions and outcomes to the treated individual, as well as the impact on caregivers and other family members (Wolf 1978).

Initial evidence of the effectiveness of ABA treatment models appeared in the 1960s with papers by Wolf, Risley, and Lovaas, who used highly structured operant learning paradigms to build behavioral repertoires and improve maladaptive behaviors of children with autism (e.g., Baer et al. 1968; Lovaas et al. 1966, 1967; Risley 1968). These behavioral programs led to increased language, social, play, and academic skills and reduced some of the severe behavioral problems often associated with the disorder. These studies were seminal in that they were the first to demonstrate empirically validated gains in children with autism. However, in addition to these promising results, data concerning maintenance and generalization indicated some limitations to their effectiveness (e.g., Lovaas et al. 1973). Subsequent research has addressed these problems, leading to enhanced effectiveness of ABA treatments for communication (Cohen et al. 2006, Sallows & Graupner 2005), social skills (McConnell 2002), and management of problem behavior (Horner et al. 2002). As demonstrated in these studies, ABA approaches have evolved and broadened to include comprehensive behavioral packages designed to address all developmental areas of need and applied across all (or an extended part) of the child's day, as well as behavioral strategies that focus on a narrow response

pattern or set of skills; both of which result in widespread and durable treatment outcomes.

COMPREHENSIVE-BASED ABA MODELS

Perhaps the most well-known of the behavioral approaches is discrete trial training (DTT; Lovaas 1981), also referred to as early intensive behavioral intervention (EIBI) if delivered before age 5 years. DTT involves breaking down complex skills and teaching each subskill through a series of highly adult-structured, massed teaching trials. Each trial or learning opportunity consists of a concise and consistent instruction for a response, typically the imitation of the therapist's model or compliance with a verbal request, and acquisition occurs through the use of explicit prompting and shaping techniques with systematic reinforcement contingent upon the child's production of the target response. Teaching trials are typically delivered in blocks over the course of 20–40 hours per week for two or more years, with skill emphasis in communication, social skills, cognition, and preacademic skills (e.g., letter and number concepts, matching) (Leaf & McEachin 1999).

In the most well known study of this method, Lovaas (1987) reported an average gain of 20 IQ points for 19 young children with autism receiving 40 hours per week of EIBI for two years or more. Initially, the treatment occurred in children's homes in order to provide highly structured one-on-one teaching. As children improved, instruction extended to facilitating social interaction and transitioning to typical preschools and other community settings. Results revealed that nine children from the EIBI group (47%) achieved average intellectual functioning (IQ over 75) and attended general education classrooms. The two other matched control groups, in which one group received only 10 hours of behavioral intervention and the other group received other types of intervention, showed virtually no changes in IQ scores. In fact, only 1 child out of the 40 comparison children was reported to have intellectual functioning in the normal range. In a follow-up study, McEachin et al. (1993) found that the intellectual and academic gains of the original EIBI group remained consistent several years after treatment, with an average of up to 13 years of age. Additional studies have attempted to replicate the original findings reported by Lovaas (1987), including one study using a randomized controlled design (Bibby et al. 2002; Cohen et al. 2006; Eikeseth et al. 2002; Howard et al. 2005; Luiselli et al. 2000; Sallows & Graupner 2005; Smith et al. 2000a,b; Takeuchi et al. 2002).

In examining findings from studies of Lovaas's treatment approach, two important points stand out. First, three groups—Cohen et al. (2006), Howard et al. (2005), and Sallows & Graupner (2005)—reported findings of best outcome status in approximately half of their groups of treated children, thus supporting Lovaas's (1987) original findings that "recovery," defined as IQs in the normal range and educational placement in typical age-level classrooms without supports, may occur for a significant subgroup of children with autism treated early enough and intensively enough. Second is that DTT delivered to young children at a high level of intensity and supervised by experienced therapists with rigorous levels of training and supervision results in marked group increases in standardized test scores. Nonetheless, children may continue to show significant deficits in intellectual, language, social, and adaptive functioning, and as many as 50% of the children who receive DTT may show no substantial change in symptoms or test scores after extensive, intensive intervention. The few comparative studies (Eikeseth et al. 2002, Howard et al. 2005) to examine effects of Lovaas's approach compared to eclectic approaches demonstrated statistically significant differences in test scores in favor of Lovaas's treatment. Thus, intensity of treatment without consistently applied ABA strategies and techniques was not sufficient for treatment effectiveness.

Although DTT has been successful for imparting important behaviors to children with autism, it has been criticized for several reasons. First, the adult-directed nature of the

Discrete trial training (DTT): an intervention approach that teaches behaviors by breaking down complex skills and teaching each subskill through a series of highly adult-structured, massed teaching trials

EIBI: early intensive behavioral intervention

PRT: pivotal response training

instruction and strict stimulus control can limit the spontaneous use of skills (Schreibman 1997a). Second, the highly structured teaching environment (Lovaas 1977) and use of artificial or unrelated reinforcers (Koegel et al. 1987) can prevent generalization to the natural environment and lead to cue dependency and rote responding (Horner et al. 1988, Schreibman 1997b). Concerns have also been noted in some applied settings with respect to the level of expertise and amount of staff time that are required in order for correct implementation of the intensive teaching procedures involved. Moreover, the use of punitive procedures following inaccurate responses may contradict other teaching philosophies (i.e., positive behavior support) adopted by many facilities.

In response to some of the difficulties associated with DTT, new behavioral interventions have been developed that include more naturalistic, spontaneous types of learning situations that embed the child's interest into teaching opportunities. These include incidental teaching (e.g., Hart & Risley 1980, McGee et al. 1991), natural language paradigm or pivotal response training (PRT; e.g., Koegel et al. 1987, Laski et al. 1988, Schreibman & Koegel 1996), and milieu teaching (Alpert & Kaiser 1992, Kaiser & Hester 1996). These treatment approaches share commonalities in terms of embedding teaching opportunities within naturally occurring events (e.g., play routines, mealtime, dressing, bath time), following the child's lead in initiating learning events, explicit prompting, reinforcing attempts, and natural reinforcement. These approaches also draw from the developmental literature, such as contingent imitation and linguistic mapping (Warren et al. 1993). Research suggests that these naturalistic approaches can address a variety of communicative functions, such as preverbal communication (e.g., eye contact, joint attention) (Hwang & Hughes 2000), spontaneous productions (Charlop & Walsh 1986), social amenities (e.g., please, thank you, hello) (Matson et al. 1993), peer interactions (McGee et al. 1992), answers to "Where is __?" (McGee et al. 1985), phoneme production (R.L. Koegel et al. 1998a), and increased talking (Laski et al. 1988).

However, there are mixed results on whether naturalistic behavioral approaches are superior to DTT for facilitating greater and sustainable child changes (Goldstein 2002). Naturalistic teaching procedures can be more easily embedded into everyday activities and reduce the need to program for generalization. As a result, a number of studies have found increased spontaneity and generalization of language gains to natural contexts and for improving efficiency in teaching acquisition and generalization simultaneously (e.g., L.K. Koegel et al. 1998b, McGee et al. 1985, Schreibman 1997a, Schreibman & Koegel 1996). In contrast to DTT, naturalistic behavioral approaches have also been reported as less aversive to children with autism and their treatment providers (e.g., parents), as evidenced by higher levels of positive affect (Koegel & Egel 1979, Schreibman et al. 1991). Children have been shown to emit fewer disruptive behaviors and to make greater improvements in verbal attempts, word approximations, word production, and word combinations during naturalistic teaching conditions compared to the discrete trial format (R.L. Koegel et al. 1992b).

An additional benefit of naturalistic interventions is the ease with which others can be taught to embed the strategies into already existing activities across multiple settings, such as the home, the classroom, and the community. Schopler & Reichler (1971) highlighted the importance of including parents of children with autism as intervention agents, without whom gains were unlikely to be maintained (Lovaas et al. 1973). Although most ABA intervention approaches include a parent education program, naturalistic interventions programs are specifically designed to fit into a family's lifestyle and routine so that teaching can occur on a regular, constant basis throughout the day in natural settings. The importance of imparting skills and knowledge to parents cannot be understated given the lack of preparation, assistance, and support parents may experience when caring for their child with autism (Koegel

2000, Stahmer & Gist 2001). Research has shown that parent education actually reduces family stress (Koegel et al. 1996, Schreibman et al. 1991) while resulting in improved child nonverbal (Anderson & Romanczyk 1999) and verbal communication (Charlop & Trasowech 1991, Laski et al. 1988, McGee et al. 1999, Stahmer & Gist 2001), behavior management (R.L. Koegel et al. 1992b, Lutzker & Steed 1998, Lutzker et al. 1998), play skills (Stahmer 1995, Stahmer & Schreibman 1992), joint attention (Rocha et al. 2007, Vismara & Lyons 2007), imitation and social responsiveness (Ingersoll & Schreibman 2006), and parent-child engagement (R.L. Koegel et al. 1996b, Mahoney & Perales 2003).

A model group program that applies naturalistic behavioral teaching—incidental teaching—in an inclusive group early childhood program to toddlers and preschoolers with autism is the Walden Early Childhood Program (McGee et al. 2001). The curriculum has developed from the philosophy that early childhood education for all young children should emphasize language and social development, that the appropriate social environment for young children with ASD is with their typical peers, and that incidental teaching techniques can provide all the support that young children with ASD need for optimal development. Hallmarks of the approach include teaching in the course of children's ongoing play activities, the use of activity schedules and designated teaching zones (LeLaurin & Risley 1972, Risley & Favell 1979), arranging environments with highly preferred materials and activities to support peer engagement, and family collaboration. At least 30 hours per week of planned instruction is provided to children to promote social responsivity to adults, social imitation and synchrony of play with peers, verbal expressive language, and independence in daily living skills, including dressing and toileting. Parent involvement is critical to teaching these key behaviors as well as identifying family priorities to develop as intervention goals.

McGee et al. (2001) described the outcome of 34 Walden graduates who began in the toddler program and continued on through the preschool and prekindergarten programs. Their data showed all 34 children acquiring some functional words, with 30 of 34 developing meaningful verbal language (defined as more than 10 words and functional unprompted speech) and 12 of 34 exiting with verbalization levels in terms of rates of production at typical ranges for kindergarten entry. Social outcome data also revealed an increased response in peer interactions, with 17 of 34 children receiving social bids from peers at levels within the ranges of 5.5-year-old typical children (range 6% to 39%). Further, 79% of the children were successfully included in regular kindergarten classes at their local public schools as documented by parent-report measures of continued social and language advancement and participation in typical extracurricular activities. The evidence provided is descriptive rather than comparative and is thus at a level of open trials. As such, it provides initial support for combining incidental teaching procedures and social inclusion to facilitate social communicative skills and promoting participation in school and community activities for young children with autism.

LEAP: Learning Experiences: An Alternative Program for Preschoolers and Parents

Other researchers have also focused on a systematic integration of social interventions within a comprehensive and long-term context of high-quality intervention for all developmental needs (Hoyson et al. 1984). The work of Strain, Hoyson, and other colleagues has contributed to the literature on developing specific social interaction interventions that occur throughout the classroom day. Their program, Learning Experiences: An Alternative Program for Preschoolers and Parents (LEAP; Strain & Cordisco 1994), provides preschool services in which children with ASD are integrated with typically developing peers. Interventions strongly emphasize (*a*) the use of an individualized, rather than fixed, curriculum to identify learning objectives and strategies to meet each child's idiosyncratic needs; (*b*) a data-driven approach to making strategic decisions about continuing, modifying, or terminating specific teaching efforts; (*c*) skill generalization

Developmental intervention: an intervention approach in which children's learning needs are derived from assessments of their developmental skills and taught in the sequence in which typically developing children learn and acquire behaviors

ESDM: Early Start Denver Model

with teaching across multiple exemplars, settings, and social partners; (*d*) maximizing naturally occurring teaching opportunities; (*e*) peer mediation to promote social initiations and contact; and (*f*) extensive parent training. Unfortunately, no controlled outcome study has been published since 1986, when the initial, uncontrolled pilot study reported that six children who entered LEAP between the ages of 30 and 53 months maintained gains from preschool to age 10, with 5 of the 6 children enrolled in regular education classrooms without special education services (Strain & Hoyson 2000). Well-designed outcome studies of LEAP would help fulfill the need for models involving effective, inclusive group education for preschoolers with ASD.

Other intervention models have adopted a developmental framework for the assessment and intervention process for young children with ASD. Unlike approaches derived from ABA, in which children's teaching goals are derived from assessment of children's behavioral deficits and excesses, a developmental model derives teaching goals from assessments of children's developmental skills. Developmental intervention models typically begin by constructing each child's developmental profile across relevant areas of functioning. In general, the assessment process includes (*a*) clinical observation(s) of child-caregiver and/or therapist-child interactions; (*b*) a developmental history and review of current functioning (typically of child, family, and caregiver); (*c*) review of current intervention programs and patterns of interaction; (*d*) consultation with specialists from other disciplines (e.g., speech language pathologists, occupational and physical therapists, educators, mental health colleagues); and (*e*) biomedical evaluation. This process leads to an individualized developmental profile that describes the child's current cognitive, communicative, and social skills (and sometimes additional domains such as motor, self-care, and play), which is then used to create individually tailored interventions in each of the domains affected by ASD in that child.

The most rigorously assessed of these models is the Denver Model and its toddler version, the Early Start Denver Model (ESDM; Dawson et al. 2010). The Denver Model is another example of a program that views ASD as a complex disorder affecting virtually all areas of functioning and thus requires an interdisciplinary approach to address a wide range of challenges. Teaching occurs inside typical family routines, such as meals, bathing, playtime, chores, and community outings, and targets all affected areas of development, with particular attention to the child's affect, attention, and arousal. Results in early studies using a prepost design controlling for initial developmental rate included significant developmental accelerations in multiple areas of development, including language and social-emotional development (Rogers & DiLalla 1991; Rogers et al. 1986, 1987; Rogers & Lewis 1989). Subsequent research has expanded the model to the infant-toddler range (i.e., the Early Start Denver Model), with initial findings of efficacy using single-subject design research (e.g., Vismara et al. 2009, Vismara & Rogers 2008).

The most recent outcome research is a randomized controlled clinical trial of ESDM funded by the National Institute of Mental Health and carried out at the University of Washington. Dawson and colleagues (2010) recruited 48 toddlers with idiopathic autism between 18 and 30 months of age who were randomly assigned to one of two groups: (*a*) an ESDM intervention group whose members received, on average, 15 hours of 1:1-delivered ESDM weekly from trained home therapists and 16 hours per week from parents for two years; and (*b*) an assessment and monitor (AM) group referred for standard community-based treatments and evaluated annually. These two groups did not differ at baseline in severity of autism symptoms, gender, IQ, or socioeconomic status. There was no attrition in the ESDM group. Two-year follow-up data were obtained for 21 community-treated children and 24 ESDM-treated children.

At two years after the baseline assessment, the ESDM group showed significantly

improved Mullen Early Learning Composite standard scores compared to the AM group. On average, the ESDM group improved 17.6 points compared to 7.0 points in the AM group. The bulk of this change appears to be due to improvements in both receptive and expressive language, which showed increases of 18.9 and 12.1 points, respectively, for the ESDM group, whereas the AM group improved 10.2 and 4.0 points, respectively; all of these differences were statistically significant. The ESDM group also showed a statistically significant 10-point advantage on the Vineland Adaptive Behavior Composite standard scores relative to the AM group due to stable scores for the ESDM group and a decline of 11.2 points for the AM group, with significant differences ranging from 6 to 13 points favoring the ESDM group on communication, daily living, and motor skills.

All children in both groups continued to have some type of ASD diagnosis at time 2, when they were, on average, 52 months old. In terms of diagnostic stability, 15 children (71.4%) in the AM group received a diagnosis of autistic disorder both at baseline and at time 2. In the ESDM group, 14 (62.5%) of the 24 children retained their diagnosis of autistic disorder from baseline to the two-year outcome. In terms of increasing symptoms, five children (23.8%) in the AM group received a PDD-NOS diagnosis at baseline and then received a diagnosis of autistic disorder at time 2. This same pattern was observed in only two children (8.3%) in the ESDM group. In terms of decreasing symptoms, one child (4.8%) in the AM group and seven children (29.2%) in the ESDM group received a diagnosis that changed from autistic disorder at baseline to pervasive development disorder not otherwise specified (PDD-NOS) at time 2, a statistically significant difference in diagnostic change between the groups.

Thus, in this rigorous two-year randomized controlled trial testing intensive delivery of ESDM at home, we found significant IQ and language differences between ESDM and AM groups that compare favorably with those published by Lovaas (1987) and that are larger and more widespread and from fewer hours of treatment than those from the randomized controlled trial of Lovaas's approach published by Smith et al. (2000b). Although ESDM needs to be independently replicated before it can be considered to be an empirically supported treatment for early ASD, these results are certainly consistent with earlier positive findings from Denver Model studies.

DIR: Developmental Individual-Difference, Relationship-Based/Floortime

A second developmental relationship-based approach that has demonstrated initial promising results is Responsive Teaching, developed by Mahoney & Perales (2003, 2005). Responsive Teaching focuses on educating parents to use responsive interaction strategies to address their children's individualized developmental needs. The program includes specific intervention objectives designed to address four developmental domains—cognition, communication, motivation, and social-emotional functioning—that have been reported to be influenced by maternal responsiveness and described as core processes for developmental gains. The authors' work indicates that parents can be encouraged to engage in responsive interactions to promote child gains in pivotal behaviors (i.e., communication, cognition, and social-emotional functioning) as well as improved engagement, cooperation, joint attention, and affect.

A third approach is the Developmental Individual-Difference, Relationship-Based (DIR) model (sometimes referred to as Floortime) that emphasizes three components: (*a*) functional emotional developmental; (*b*) individual differences in sensory modulation, processing, and motor planning; and (*c*) relationships and interactions (Greenspan 1992, Greenspan & Wieder 1998). Rather than focusing on isolated behaviors or skills, the DIR/Floortime approach integrates functional emotional development and differences that underlie particular symptoms or behaviors to establish a relationship that creates interactive, affective opportunities of engagement. The goal is to enable children to develop a

Comprehensive intervention: an intervention model that addresses multiple core deficits in autism spectrum disorder, including language, social, cognition, and play

sense of themselves as intentional interactive individuals and to build cognitive, language, and social capabilities from this sense of intentionality. The approach often involves three types of activities: playful, spontaneous, and creative interactions initiated and led by the child with support from the adult to both follow and challenge the child; semistructured, problem-solving interactions to introduce new skills, concepts, and target academic goals (e.g., searching for a missing object, mastering spatial concepts); and motor, sensory, and spatial play to strengthen fundamental processing skills.

Research examining the efficacy of the DIR/Floortime approach includes a case review of 200 children, all of whom had started the intervention between 2 and 4 years and had received between 2 and 8 years of intervention, follow-up consultation, or both (Greenspan & Wieder 1997). The children were divided into three groups based on their response to the program. The good-to-outstanding outcome group shifted into the nonautism range on the Childhood Autism Rating Scale (CARS; Schopler et al. 1988), advanced in various social, cognitive, and motor-based tasks, and used words and symbols communicatively and purposefully. The second, or medium, group demonstrated slower and more gradual progress but still improved in their ability to relate and communicate with gestures and developed some degree of language. The third group made very slow progress, and although most learned to communicate with gestures or simple words and phrases, they had continued difficulties with attention, self-stimulation, and perseveration.

Subsequent to this study, Wieder & Greenspan (2005) conducted a 10- to 15-year follow-up study of 16 male children between the ages of 12 and 17 years who were in the good-to-outstanding group of the original 200 children. The study reported maintained gains in relating, communicating, and reflective thinking, with most performing at average to above average in academic areas. For this subgroup of children, the core deficits and symptoms of ASD were no longer observed 10 to 15 years after they initially presented. Additional research has examined the impact of parent coaching and community-based application of the model to address children's social, cognitive, and language functioning (Solomon et al. 2007). Rigorous controlled studies of DIR are needed to confirm relationships between the model's teaching practices and children's progress.

Other comprehensive behaviorally based programs have been developed for children and adults with ASD and take place in specialized classrooms, residences, or occupational settings. Unlike early intervention programs that provide more intensive, individualized, structured teaching, programs such as the Eden Family of Services (Holmes 1997) and the Adult Life-Skills Program as part of the Princeton Child Development Institute (McClannahan & Krantz 1997) aim to provide a continuum of educational, residential, and employment programs to supply the seamless permanent support network that individuals with autism and their families desperately need. These programs facilitate participation in group activities and promote the ability to complete tasks independently, without direct supervision. In addition to community participation, the curriculum focuses on skills in such areas as keyboard use, language development, money management, recreation and leisure, self-care, social interaction, and time telling (McClannahan et al. 2002). Services are delivered in multiple settings, including community workplaces, learners' own homes, and recreation and entertainment facilities where trainers model target skills, provide supervised practice opportunities, and deliver immediate positive and corrective feedback (McClannahan & Krantz 1985). Although it is evident that individuals with ASD in these programs learn many new skills, there is still insufficient evidence on long-term outcomes, such as whether participants in the programs continue to progress afterward in less specialized or supported settings (McClannahan et al. 2002).

SKILLS-BASED APPLIED BEHAVIOR ANALYSIS MODELS

We have thus far been discussing comprehensive intervention models that address a great many learning needs at once; however, a variety of interventions for teaching specific skills have been developed, empirically examined, and published in the autism literature. These interventions differ from each other across multiple factors, such as the age group of the people with autism involved, the target behavior of the intervention (e.g., social skills, communication, adaptive behavior), the kind of social partner involved (e.g., peer or adult), the intervention strategy applied, and the characteristics of the interventionist (e.g., adult or peer). However, almost all the published interventions involve a behavioral methodology, requiring a concise definition of the target behaviors to be taught, the inclusion of task analysis, careful measurement of the acquisition of the behavior, maintenance of the behavior under more natural reinforcement conditions, and generalization to other settings, persons, and behaviors.

Picture Exchange Communication System.

One such intervention is the Picture Exchange Communication System (PECS; Bondy & Frost 1994, 1998) developed for nonverbal children with ASD. PECS aims to teach spontaneous social-communication skills through the use of symbols or pictures, and teaching involves behavioral strategies, particularly reinforcement techniques, for the child to learn to use functional communicative behaviors to request desired items (Frost & Bondy 2002). Initially, the child is physically prompted to pick up and exchange a symbol/picture for the desired object (i.e., Phase I: Physical Exchange). In Phase II: Expanding Spontaneity, children are taught to exchange a symbol with a communicative partner who is not in proximity and to persist until their response is met. Prompts are then faded using backward chaining techniques. Once a child is using symbols with some flexibility, having learned to seek out a communicative partner and generalize skills to other adults, Phase III: Picture Discrimination is begun, in which the child learns to discriminate among symbols to request preferred objects. In Phase IV: Sentence Structure, the child is taught to apply an "I want" symbol to a blank sentence strip, combine it with the symbol of the desired object, and to exchange the sentence strip with the communication partner. Then, in Phase V: Responding To "What Do You Want?", the child learns to respond to this direct question. Finally, in Phase VI: Responsive and Spontaneous Commenting, additional skills are encouraged, such as responding to other questions (e.g., "What do you hear?").

PECS: Picture Exchange Communication System

Several studies have evaluated the effects of PECS instructions and have been rated as inconclusive; as such, the studies carry little weight for the efficacy of this approach (Beck et al. 2008, Buckley & Newchock 2005, Frea et al. 2001, Ganz & Simpson 2004, Marckel et al. 2006, Son et al. 2006, Yokoyama et al. 2006). Although carried out with smaller samples, other studies have found PECS to be fairly effective in terms of requesting, commenting, and language expansion (Kravits et al. 2002, Tincani et al. 2006) and in improving eye contact, joint attention, or play as well as requests and initiations (Charlop-Christy et al. 2002).

Two group studies conducted by Yoder & Stone (2006a,b) yielded more convincing evidence. In a randomized controlled trial, they compared PECS with Responsive Education and Prelinguistic Milieu Teaching (RPMT) in 36 children with ASD. The first study examined speech production as its outcome measure and found that PECS increased the rate of nonimitative spoken communicative acts and the number of different nonimitative words in nonverbal children with ASD compared to RPMT. An additional exploratory analysis showed a faster progression rate of the number of different nonimitative words with PECS than with RPMT for children who exhibited more object exploration prior to starting treatment. However, children with little object exploration skills at preintervention responded better to RPMT than to PECS. The second study involved the same children and found that RPMT led to

SGDs: speech-generating devices

generalized turn-taking and generalized joint attention initiations more than the PECS for those children who began intervention with some joint attention skills. In contrast, children with very little joint attention skills responded better to PECS than to RPMT.

In another randomized controlled trial, Howlin et al. (2007) provided extensive PECS training and consultation to teachers of nonverbal children with ASD in specialist school settings. Although expert guidance to teachers led to increased PECS usage, the study did not demonstrate increases in spoken language or scores on language tests, and significant impairments in the children's communication skills were maintained. A follow-up period of one treatment group also revealed that treatment effects were not maintained once classroom consultations ceased. Additional studies are needed to examine the potential value of PECS for nonspeaking children with autism, and additional intervention strategies may need to be developed to foster easier use of this approach across children's environments and greater incorporation of the approach into natural routines at home and in the community.

Investigators have also compared PECS training to manual signing in terms of acquisition and use of language. Signs represent another symbolic system for representing objects and actions that individuals with ASD might be motivated to request, label, and comment upon. In the past, manual signing has been thought of as a viable option for children with poor verbal imitation skills because most children can imitate (or be taught to imitate with physical prompting and fading procedures) a few fine or gross motor movements (Sundberg & Partington 1998). At the same time, children using manual signs to unaware or unskilled communicative partners will have great difficulty being understood (Mirenda & Erickson 2000). Tincani (2004) compared manual signing with PECS in teaching requesting and speech production. Manual signing was found to be fairly effective for two of the participants in the case of requesting, but not as effective as PECS. The remaining two participants showed increased vocalizations after manual signing, yielding positive results over PECS. Overall, the aggregated evidence suggests that PECS is more efficient than manual signing related to requesting; however, it remains unclear as to which approach is more effective for targeting speech production. A rigorous review by Schwartz & Nye (2006) confirmed the effectiveness of manual signing for children with autism in sign production and speech production, but this is qualified by the very small number of high-quality studies on teaching manual signing to children with ASD (see Brady 2007 for additional information).

Speech-generating devices. Speech-generating devices (SGDs) provide digitized and/or synthetic speech when activated. Intervention studies have evaluated the effects of SGDs as part of a treatment package or examined speech production as an outcome measure. Although some results have been inconclusive (Dyches 1998, Sigafoos et al. 2003, Son et al. 2006), other studies found that embedding SGDs within naturalistic teaching strategies increased communicative interactions and behaviors in children with autism (Olive et al. 2007, Schepis et al. 1998, Sigafoos et al. 2004). Another study compared teaching requesting of preferred objects using an SGD with the speech on versus the speech off to five children with autism (Schlosser et al. 2007). The authors reported no significant differences across conditions or children. The results were unreliable, with only two children showing some improvement in use of vocalizations.

Self-management. Self-management is another option for teaching individuals with autism to increase independence and generalization of newly acquired behaviors without the need for constant supervision by a treatment provider (Koegel et al. 1995, Pierce & Schreibman 1997, Schreibman & Koegel 1996). Self-management typically involves self-evaluation of performance, self-monitoring (ideally in the absence of an adult), and

self-delivery of reinforcement. The procedures have been used with children of different ages to target a variety of skill areas, such as academic performance (Shimabukuro et al. 1999), conversational skills (L.K. Koegel et al. 1998a), and disruptive and/or perseverative behavior (Newman et al. 2000). Stahmer & Schreibman (1992) used a self-management treatment package to increase levels of functional play in three school-aged children with autism, who prior to intervention typically engaged in inappropriate or self-stimulatory behavior when left on their own. Self-management training taught the children to play appropriately in the absence of a supervising adult, and skills generalized to new settings and toys. Decreases in self-stimulatory and disruptive behaviors were maintained in the unsupervised settings, and two of the three children maintained the play skills at one-month follow-up. Newman et al. (2000) extended the self-management research by teaching children with autism to vary their play responding, thereby reducing inappropriate forms of play. Three preschool-aged children showed increases in variability of play after self-management training, with the behavior sustaining at a one-month follow-up. Other studies have successfully employed self-management to increase social initiations while reducing challenging behaviors (L.K. Koegel et al. 1992a), to increase independent interactions with typical peers (Shearer et al. 1996), and to improve untreated social communicative behaviors and overall appropriateness of the children's social interactions (Koegel & Frea 1993).

Positive Behavior Support. Another skill-based approach to empowering individuals with ASD and building autonomy is through Positive Behavior Support (PBS) strategies. PBS appeared in the 1980s as an alternative to aversive interventions for people with severe disabilities. Since then, it has expanded to address the behavioral support needs of a diverse population of individuals with ASD. PBS is a collaborative, assessment-based approach to addressing problem behavior that integrates the procedural tools of behavioral science with person-centered values and a systems perspective (Lucyshyn et al. 2002). PBS aims to improve the behavior and quality of life of people who engage in problem behavior and to do so in ways that are effective, acceptable, feasible, and durable when implemented by educators, families, and other support providers in typical home, school, and community settings (Horner et al. 2000, R.L. Koegel et al. 1996b). In addition, PBS embodies the philosophy that people with developmental disabilities should be included and integrated in the same settings and provided with the same opportunities as other people. To assist with this ideal, service providers of PBS build partnerships with families to develop a vision of the individual's inclusion in family and community life and to develop goals and plans that fit within the cultural and ecological framework of the individual's family and community (Albin et al. 1996, Moes & Frea 2000, Vaughn et al. 1997). Thus, parent involvement and training are strongly emphasized so that families are supported to accurately implement behavior support strategies, to facilitate lasting changes in behavior and in quality of life, and to address new or recurring behavior problems with little or no professional involvement (Dunlap et al. 2000). The importance of enhancing meaningful lifestyle outcomes for the individual and family has also led to the development of person-centered planning methods in PBS (Fox et al. 1997, Harrower et al. 1999–2000). Person-centered planning is a collaborative process to develop a vision of an inclusive lifestyle for the individual and an action plan to achieve those steps leading toward the vision. The behavior support plan offers the strategies and tools necessary to help the individual, family, and team accomplish the goals. PBS advocates that in addition to evaluating treatment strategies on their efficacy, equally important is how the strategies enhance choice-making opportunities, respect, and the personal dignity of the individual for which they are used.

The fact that PBS aims to prevent problem behavior rather than utilize consequential

FCT: Functional Communication Training

methods following the behavior has led to a strong understanding of the variables that influence behavior, particularly the impact of ecological variables (i.e., setting events) and immediate antecedent events on behavior (Horner et al. 1996, Luiselli & Cameron 1998, Smith & Iwata 1997). In turn, a wide range of antecedent-based techniques have been adopted, such as building activity patterns, offering choices, and using visual schedules to promote predictability of routines (Repp & Horner 1999, Scotti & Meyer 1999). A second development is the use of functional assessment for understanding problem behavior and for designing effective interventions that integrate proactive and educational strategies and reinforcement-based procedures to facilitate lifestyle improvements (Horner & Carr 1997, Iwata et al. 1994, O'Neill et al. 1997). This process involves identifying the events that reliably predict and maintain problem behaviors so that changes relating to behavioral improvements can be introduced to those events (O'Neill et al. 1997). Thus, the goal is to create effective environments in which positive behavior is more functional than problem behavior.

Functional Communication Training. A strong relationship exists between the ability to communicate and the prevalence of problem behavior in individuals with ASD. When individuals with ASD are taught communication skills that serve efficiently and effectively as alternative behaviors, reductions in problem behaviors result (Bird et al. 1989; Carr & Durand 1985; Durand & Carr 1987, 1992; Horner & Budd 1985). PBS encompasses Functional Communication Training (FCT) to teach individuals to emit an appropriate alternative communicative behavior to obtain the same reinforcer determined to maintain the problem behavior while the problem behavior is placed on extinction, or ignored so that the reinforcing consequence is removed (Durand 1990). Different communication modes such as real object or tangible symbols, photographs, written word cards, speech, simple gestures, manual signs, and even voice output communication aids may be used to teach the individual to communicate in a way that matches the function of the behavior. For example, a child who throws objects or toys to protest or to escape a nonpreferred activity could be taught to verbalize "no" or to sign "done" in order to appropriately refuse or end the task. A teenager who engages in embarrassing, disruptive behavior to escape loud noises whenever taken into the community could learn to ask for a break with the use of a card when noises become too overwhelming. FCT has been demonstrated to be an effective treatment for individuals with developmental disabilities, including ASD, who exhibit severe behavior problems (e.g., Bailey et al. 2002; Carr & Durand 1985; Fisher et al. 1993, 2000; Hagopian et al. 1998, 2005). Broader generalization and greater maintenance of effects are also associated with FCT when a variety of natural contexts are included (Durand & Carr 1992, Horner & Budd 1985). More recently, Bopp et al. (2004) identified 16 FCT studies and Mancil (2006) covered 8 FCT studies that used intervention procedures that included extinction, ignoring, and/or redirection combined with communication techniques of various kinds (e.g., manual signing, picture symbols, printed words, SGDs). Although both reviews arrived at the decision that FCT was effective for eliciting the new communicative behaviors and reducing the frequency of challenging behaviors, Schlosser & Sigafoos (2008) warned readers to interpret the findings with caution owing to methodological limitations (e.g., incomplete inclusion/exclusion criteria, lack of inter-rater agreement, incomprehensive search).

Reciprocal imitation training. In addition to promoting verbal language skills, intervention programs have focused on teaching earlier-emerging nonverbal social-communication skills to children with ASD (Drew et al. 2002, Mahoney & Perales 2003). Imitation is a nonverbal social-communication skill that is significantly impaired in children with ASD (Charman et al. 1997, Rogers et al. 2003, Smith & Bryson 1994), yet emerges early in

development and plays a crucial role in the development of more complex cognitive and social skills (Stern 1985, Uzgiris 1981). Prior research has shown imitation ability in children with ASD to be associated with language (Stone & Yoder 2001), play (Stone et al. 1997), and joint attention (Carpenter et al. 2002). As such, researchers have suggested that teaching young children with ASD to imitate may improve their social-communicative development more broadly (Carpenter et al. 2002, Rogers 1999, Rogers & Bennetto 2000).

Reciprocal imitation training (RIT; Ingersoll 2008) is a naturalistic intervention designed to teach the spontaneous social use of imitation to young children with ASD during ongoing play interactions. RIT employs naturalistic intervention strategies similar to PRT (Koegel et al. 1987, 1989), incidental teaching (Hart & Risley 1968, McGee et al. 1983), and milieu teaching (Alpert & Kaiser 1992, Kaiser et al. 1992), including following the child's lead, explicit prompting, reinforcing attempts, and natural reinforcement in addition to techniques from the developmental literature (e.g., contingent imitation, linguistic mapping) (Warren et al. 1993). Previous research has demonstrated that RIT is effective for teaching both object (Ingersoll & Schreibman 2006) and gesture imitation (Ingersoll et al. 2007); in addition, it leads to collateral changes in other social-communication skills, including language, pretend play, and joint attention (Ingersoll & Schreibman 2006). It has also been demonstrated as an appropriate parent training intervention for promoting spontaneous imitation with maintained and generalized skill use and has received positive parent satisfaction ratings for ease of use and effectiveness (Ingersoll & Gergans 2007).

SUMMARY

In closing, intervention for children with ASD is a politically heated and scientifically multifaceted topic. As discussed throughout this review, a multitude of research articles document the effectiveness of many different ABA comprehensive and skill-based methods for teaching a variety of skills in communicating, interacting with adults and peers, playing and engaging in activities, performing self-help skills and tasks, and regulating problem behavior. Efforts in research continue to refine these methods, including the need to (*a*) determine which areas of development when targeted will lead to a greater amount of change in children's learning rates over time and in long-term outcome measures of skill; (*b*) differentiate manualized, empirically supported teaching practices from general eclectic approaches that mix a variety of approaches (some of which have no scientific evidence) to teach children; (*c*) conduct more comparative studies to identify the most effective combinations of curricular sequences and teaching practices for specific outcomes; and (*d*) develop empirically supported treatments for infants at risk for ASD, given the current emphasis for earlier detection (Filipek et al. 1999).

In particular, the push for early detection and more effective interventions has led researchers to examine whether the prevention of ASD is plausible by altering the course of early behavioral and brain development (Dawson 2008). Dawson and colleagues (e.g., Dawson & Faja 2008, Dawson et al. 2009) have proposed a model outlining the genetic, environmental, and phenotypic risk indices that early intervention will need to address in order to alter the abnormal developmental trajectory that young children with ASD face. Specifically, the authors posit that early genetic and environmental risk factors contribute to an atypical trajectory of brain and behavioral development, which is then manifest in the child's lack of ability to actively engage in social interaction. An important consequence to this compromised neural-behavioral network is the missed opportunities for normal social and linguistic input (typically involved in social exchanges) that promotes the development of social and linguistic brain circuitry during early critical growth periods. Early intervention that facilitates reciprocal social interactions and

RIT: reciprocal imitation training

Naturalistic intervention strategies: an intervention approach that applies the behavioral teaching principles of applied behavior analysis within the child's natural environment

engagement with a partner may guide brain circuitry—its acquisition, organization, and function—in addition to behavior development back toward a normal pathway. Current efforts are under way in the field of infant-toddler autism intervention to examine the impact of earlier intervention for reducing and preventing ASD symptoms (Chandler et al. 2002, Drew et al. 2002, Green et al. 2002, Mahoney & Perales 2003, McGee et al. 1999). As described above, one of the first randomized studies of infant-toddler intervention has been reported by Dawson and colleagues (2010); in this study, noteworthy gains are reported in cognitive, language, and social abilities and ASD symptoms. However, the next step for intervention and prevention studies is to demonstrate that earlier efforts can result in more normal patterns of brain function and organization. Incorporating brain-based measures of outcome into studies will provide insight into the effects of early intervention on brain functioning in ASD.

Further research into these areas will provide information on the variables that mediate and moderate treatment effects and the kinds of intervention that are most efficacious, as well as the degree of both short-term and long-term improvements that can be expected in affected individuals. By pursuing these areas of research, it is hoped that the quality of lives for children with ASD and their families will be substantially improved.

SUMMARY POINTS

1. ABA is an educational-behavioral intervention for children with ASD that has generated the most extensive research and thus has been identified as the treatment of choice to address learning deficits.
2. ABA is an applied science integrated in diverse educational settings and aimed at understanding the functional relations between environmental events and behavior in order to produce socially significant changes.
3. The most favorable outcomes are suggested to occur when ABA programs are started early in life (before age 5 years) and implemented intensively (20 hours or more per week for two or more years). Early intensive ABA intervention programs are intended to be comprehensive, targeting all areas of development, and may result in accelerated gains, including increased scores in IQ and other standardized tests; enhanced communication, cognition, and socioemotional functioning; and mainstreamed school placements.
4. Comprehensive ABA programs in classrooms and residential settings have also been developed for older children and adults with ASD. In addition, programs exist that target a more circumscribed and specific set of skills and behaviors; these programs may include training of parents, teachers, peers, or others to implement interventions.
5. Research suggests that both comprehensive and skills-based programs produce positive short-term benefits, but additional evidence on long-term effects is needed.

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RELATED RESOURCES

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Schreibman L. 2005. *The Science and Fiction of Autism*. Cambridge, MA: Harvard Univ. Press. A wealth of information regarding scientifically valid versus ineffective interventions for children with ASD.

Smith T, Mozingo D, Mruzek DW, Zarcone JR. 2007. Applied behavior analysis in the treatment of autism. In *Clinical Manual for the Treatment of Autism*, ed. E Hollander, E Anagnostou, pp. 153–77. Arlington, VA: Am. Psychiatr. Publ. The chapter evaluates various ABA psychosocial treatments for treating children with ASD. Their explanation of current research contributes to the literature on efficacious intervention approaches to help advance the care that children with ASD should receive.

Weiss MJ, Fiske K, Ferraioli S. 2008. Evidence-based practice for autism spectrum disorder. In *Clinical Assessment and Intervention for Autism Spectrum Disorder*, ed. J Matson, pp. 33–65. Burlington, MA: Elsevier. A literature review of effective programs and methods for children with ASD as well as recommendations for professionals and families navigating intervention decisions.

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