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Communication Disorders Quarterly 2009; 31; 15 originally published online Jan 20, 2009;

DOI: 10.1177/1525740108324097

The online version of this article can be found at:
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Evaluation of the Efficacy of Communication-Based Treatments for Autism Spectrum Disorders

A Literature Review

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This literature review examines the present level of evidence in support of communication-based treatments for children with autism spectrum disorders. Reviews to date have reported on research published through 2002. The current article included 36 studies published between 2002 and 2007. Best available evidence is presented for seven treatment categories: applied behavior analysis, naturalistic behavioral, developmental, classroom-based, video modeling, social skills, and augmentative and alternative communication. Findings indicate that empirical support has been obtained for the efficacy of several methods, whereas other methods remain in an exploratory stage of investigation.

Keywords: *communication; evidence-based practices; autism; literature review*

Autism is characterized by marked social and communication impairment, as well as restricted or repetitive behaviors and interests (American Psychiatric Association, 2000). It is frequently referred to as *autism spectrum disorder* (ASD), which includes autistic disorder, Asperger syndrome, and pervasive developmental disorder—not otherwise specified (American Speech-Language-Hearing Association, 2006). As the second-most common developmental disorder among children (after mental retardation), ASD is estimated to occur in 1 out of 150 children, with a higher prevalence among boys than girls (Centers for Disease Control and Prevention, 2007). Clinicians and educators will attest that given recent increases in the incidence of autism (Blaxill, 2004; State of California Department of Developmental Services, 1999), along with the heterogeneity of symptoms and severity, providing services and treatment for children with this debilitating condition is frequently challenging.

There has been a strong move toward evidence-based practice in recent years (American Speech-Language-Hearing Association, 2006). A cursory examination of the autism literature yields treatment approaches quite diverse in their philosophy, methods, and outcomes, which renders the task of identifying the most appropriate

practices rather daunting. Since Rogers (1998) concluded that the efficacy of autism treatments has not yet been well established, additional efficacy research has emerged. Goldstein (2002) authored a general review of treatment efficacy studies published through 2001 and reported that considerable evidence supporting the effectiveness of communication-based interventions for children with ASD—in particular, those involving discrete trial training, natural milieu, and sign language. According to Odom et al. (2003), studies of early intervention practices that were conducted between 1990 and 2002 provide well-established evidence for treatments that were adult directed and/or based on differential reinforcement. Furthermore, the researchers found evidence for emerging and effective practices, such as peer-mediated intervention, use of visual supports (e.g., the Picture Exchange Communication System [PECS]), self-monitoring techniques, and family- or parent- based intervention. Finally, Simpson et al. (2005) examined studies of prominent autism interventions by treatment category (e.g., skill based, interpersonal, cognitive, physiological) and

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concluded that there is compelling empirical support qualifying some treatments as evidence-based practices (i.e., applied behavior analysis, discrete trial teaching, pivotal response training [PRT]).

A recent Academic Elite EBSCO search yielded more than 200 peer-reviewed studies (published since January 2002) that address autism treatment. The present review aims to evaluate this literature with an emphasis on communication-based treatments. As such, this article addresses the following questions:

- What is the current state of empirical evidence for communication-based treatments of autism?
- What recommendations can be made for future research to improve on the present literature base?

Method

Several inclusion criteria were established to select appropriate studies for the current review. First, articles were published between January 2002 and June 2007. Second, study participants primarily included children with ASDs. Third, the treatment method studied addressed prelinguistic skills, language, or social pragmatic outcomes. Fourth, the type of treatment fell into one of the following categories: applied behavior analysis, naturalistic behavioral, developmental interventions, classroom-based interventions, video modeling, social skills intervention, or augmentative and alternative communication. And fifth, this review includes only the best available evidence for each category of treatment and stage of research, based on Robey's five-phase model (2004) for outcome research (e.g., controlled group designs, single-subject designs with multiple baselines or alternating treatment, meta-analysis of single-subject studies). The following is a brief description of Robey's five-phase model:

- Phase 1 research includes the earliest level of investigation intended to identify the existence of a therapeutic effect and possibly estimate the effect size. Studies during this phase typically include case studies, retrospective designs, precomparison/postcomparison studies with small sample sizes, and single-subject studies that are exploratory.
- Phase 2 research sets the foundation for clinical trials conducted in Phase 3 by measuring effect size and by refining research methods that are to be used in a larger-scale investigation. Like those of Phase 1 research, Phase 2 study designs may include case studies, single-subject studies, and small group studies.
- Phase 3 research measures the efficacy of an intervention via a clinical trial. Experimental control is

critical, and study designs include case-control studies, parallel-group studies, and rigorous single-subject studies with multiple baselines.

- Phase 4 research is primarily conducted in the field, with the goal of testing the effectiveness of an intervention in a clinical setting. Designs include variations of Phase 3 trials, as well as meta-analyses of Phase 3 research.
- Phase 5 represents the final level of outcome-based research and focuses largely on cost-effectiveness in community-based settings.

Ideally, this review would have been limited to an examination of randomized controlled trials (i.e., Phase 3), which represent the gold standard for efficacy research (Robey, 2004). Unfortunately, such designs continue to be the rare exception in research with the ASD population. After careful review of the literature, a total of 36 studies satisfied the criteria for inclusion and are detailed in the appendix with regard to their methods and results.

Results

Applied Behavior Analysis

Applied behavior analysis (ABA) is grounded in operant conditioning and involves intensive one-on-one instruction designed to teach positive behaviors and eliminate negative ones (Lovaas, 1987). Discrete trial training is one frequently used type of ABA method that involves simplifying skills into manageable tasks, which are taught using mass trials (Whalen & Schreibman, 2003).

ABA methods (including discrete trial training) have been the subject of controversy and debate (see Heflin & Simpson, 1998; Simpson, 2001). Current proponents advocate its individualistic focus, utility with a range of target behaviors (e.g., language, social, self-care skills), and replicable effects (e.g., Rogers, 1998). Lovaas (1987) asserted that for some children, ABA offers a means to recovery from autism. Critics have taken issue with this claim and have questioned the extensive use of ABA methods (e.g., 40-plus hr per week) to the exclusion of other concomitant treatment methods (Heflin & Simpson, 1998). Furthermore, some perceive these methods as resulting in "prompt-dependent children" (Simpson, 2001, p. 70) who cannot generalize learned behaviors to natural settings and who frequently lack the motivation to comply with the treatment. Despite conflicting opinions, researchers have reported empirical support for ABA methods. According to Odom et al. (2003), adult-prompting and differential reinforcement, both elements of discrete trial training, are well-established

treatment methods. Furthermore, Simpson et al. (2005) argued that support for ABA and discrete trial training is strengthened by the data-driven methods employed during intervention.

Recent studies of ABA have addressed the effectiveness of these methods under varying conditions and for specific subgroups (Eikeseth, Smith, Jahr, & Eldevik, 2002; C. Jones & Schwartz, 2004; Stoelb et al., 2004). Eikeseth et al. (2002) compared ABA with an intensive use of eclectic special educational services (e.g., TEACCH, sensorimotor therapy). Findings indicate significantly greater gains for the behavioral group on all measures after 1 year of treatment, including significant improvements in IQ, language, and adaptive behavior. In addition, children in the behavioral group were found to be significantly more likely to have follow-up IQs in the average range than were children in the eclectic group, despite no significant initial differences between these two groups.

A retrospective study by Stoelb et al. (2004) investigated the relationship between pretreatment factors (e.g., age at onset of treatment, presence of a sleep or seizure disorder, history of symptom regression, pretreatment functioning) and treatment outcomes from ABA and found that children with physical dysmorphism demonstrated a poorer response to treatment than did others. Also, a history of symptom regression was predictive of poorer outcomes at 12-months post-onset. Further analysis revealed that younger children with some pretreatment linguistic skills and no history of symptom regression were more likely to respond to ABA treatment with greater improvement in overall performance.

C. Jones and Schwartz (2004) studied the effects of utilizing peer and sibling models (as opposed to adult models) to demonstrate target behaviors for children with ASD. They reported that all three children reached criterion levels for verbal labeling on all stimulus sets under both the peer and the sibling modeling conditions, but only one did so under the adult modeling condition. The authors concluded that peer and sibling models were, at minimum, as effective as adult models; however, no consistent preference for one type of model was demonstrated among the three participants.

Summary. The best available evidence indicates that the efficacy of ABA methods as an intervention for adaptive behavior and broadly defined language is well established. According to Robey's five-phase model (2004), Eikeseth and colleagues' study (2002) contributes to the evidence as a clinical trial to test efficacy, in that it

employs a parallel-group design with a gain-score analysis and report of effect size. And while Stoelb and colleagues' retrospective study (2004) may be considered discovery oriented (per Robey), the findings expand our understanding of how subgroups of children with autism, based on pretreatment variables, may respond to ABA treatment. Last, C. Jones and Schwartz's study (2004) represents a later-stage investigation of treatment effectiveness under a procedural variation (Robey, 2004).

The findings from these studies (Eikeseth et al., 2002; C. Jones & Schwartz, 2004; Stoelb et al., 2004) are all clinically relevant and may prove useful for professionals working with children who have ASD. First, peers and siblings may prove as effective (or more effective) as models of target behaviors when compared to educational professionals (C. Jones & Schwartz, 2004). In addition, examination of pretreatment characteristics of children with ASD may result in more appropriate decision making regarding treatment (Stoelb et al., 2004). Rather than subject children with physical dysmorphism or a history of symptom regression to hundreds or thousands of hours of discrete trial training with minimal benefit, we might consider other, more efficient treatment methods or focus on more functional goals. However, although young children with pretreatment language abilities and an absence of symptom regression demonstrated the greatest gains with ABA treatment, it is unclear whether improvements reflect actual mastery of new skills or, instead, prompt dependency. These same children might have been shown to make even larger treatment gains with another more naturalistic or developmental treatment method.

Naturalistic Behavioral Approaches

Naturalistic behavioral methods were developed to address the limitations of ABA and discrete trial training (e.g., inadequate generalization, prompt dependence, nonmotivation). Although these methods employ some elements of behavioral training, they are conducted in natural environments and are designed to motivate children with autism (R. L. Koegel, Camarata, Koegel, Ben-Tal, & Smith, 1998). Within this category are three leading interventions with available research—namely, milieu teaching, functional communication training, and PRT.

Milieu teaching. The milieu teaching approach (or milieu language training approach) incorporates three components: incidental teaching, mand model, and time

delay. Incidental teaching uses naturally occurring situations, coupled with the child's interests, to teach language (Goldstein, 2002). Hence, the learning environment is carefully designed to maximize the likelihood of the child's initiating communication with the adult (Warren & Kaiser, 1986). Using the mand model procedure, a teacher or clinician follows up on the child's interest by demonstrating a verbal mand (request) for the child to imitate and then uses natural reinforcement for this imitation (e.g., giving the child the desired object; Alpert & Kaiser, 1992). Time-delay procedures form an approach where a preset delay occurs between the presentation of a highly desired stimulus (e.g., child's favorite toy) and a prompt by the adult, thereby providing the child with an opportunity to initiate a request. In short, milieu teaching procedures can be easily integrated into a child's everyday activities and are thought to facilitate the generalization of learned communication skills (Goldstein, 2002).

Extensive research has examined the usefulness of milieu teaching methods and their application to targeting communication goals (see Goldstein, 2002). Odom et al. (2003) pointed out that well-established methods, such as adult prompting and differential reinforcement, have been successfully applied to naturalistic contexts. Furthermore, recently published randomized group studies (Kasari, Freeman, & Paparella, 2006; Yoder & Stone, 2006a, 2006b) have advanced the level of evidence for milieu teaching to one of empirically demonstrated efficacy.

Kasari et al. (2006) utilized milieu teaching and found that when compared with controls, the children whose treatment focused on joint attention produced significantly more initiating behaviors and demonstrated significantly more responsiveness to the joint attention bids of others during structured assessment. These children also exhibited significantly more child-initiated joint attention with their mothers on posttreatment observation. Similarly, the children whose treatment focused on play demonstrated a significantly greater level of play and a significantly greater use of symbolic play during mother-child interactions, when compared to the joint attention group and the control group, thereby suggesting generalization of skills. This study thus demonstrated some specificity of treatment by comparing two groups with different treatment targets. The authors pointed out that the control group did not make any gains in joint attention or play skills, despite the intensive individualized treatment that its members were receiving within their early intervention program.

Two other studies (Yoder & Stone, 2006a, 2006b) compared the use of responsive education and prelinguistic milieu teaching (RPMT) with that of the PECS in

improving joint attention, turn-taking skills, and the acquisition of non-imitative words in 36 preschoolers with ASD. Evidence for the use of RPMT is presented here, whereas findings supporting the use of PECS are discussed later. RPMT was developed to address key prelinguistic pragmatic functions, such as initiating joint attention, requesting, and turn-taking, and it served as a precursor for traditional milieu language training (Yoder & Stone, 2006a). Yoder and Stone (2006a) found that at the conclusion of the study, their RPMT group demonstrated significantly more object exchange turns than did the PECS group. Also, among children who could already initiate some level of joint attention at pretreatment, RPMT resulted in significantly greater improvement in initiating joint attention and requesting. Findings from Yoder and Stone (2006b) indicated that children who exhibited low levels of object exploration at pretreatment benefited more from RPMT than from PECS in terms of the number of different non-imitative words they produced at 6-month follow-up. The authors concluded that their studies demonstrated the differential efficacy of RPMT for targeting prelinguistic pragmatic behaviors and expanding spoken communication, depending on pretreatment characteristics of the child with ASD. Furthermore, the large effect sizes obtained suggest that even "relatively low-intensity treatments can lead to important gains" (Yoder & Stone, 2006a, p. 433).

Functional communication training. Challenging behaviors frequently observed in children with ASD (e.g., tantrums, aggression, self-injury, stereotypic behavior) may be the targets when teaching appropriate communication skills via functional communication training (Goldstein, 2002). Successful functional communication training begins with determining the motivation or purpose of a challenging behavior and then teaching a replacement behavior (e.g., socially appropriate communication) using desirable objects or activities as motivators. Functional communication training has recently been adapted to the home setting (e.g., Mancil, Conroy, Nakao & Alter, 2006), where training has the potential for greater generalization and maintenance of skills (Goldstein, 2002).

Most of the published research on functional communication training is limited to single-subject studies. Only one study met the inclusion criteria for the current review. Mancil et al. (2006) sought to replace the aberrant behavior of a 4-year-old boy with ASD who had a history of tantrums and limited language use. Using functional communication training focused on mand training with four highly preferred activities, the researchers reported the

elimination of tantrums and an increase in spontaneous verbalizations (from 2 words to 50), as well as the onset use of two- and three-word combinations. Moreover, the study found evidence for generalization of these language skills to other people (i.e., parents) and across other tangible items.

PRT. Like milieu teaching and functional communication training, PRT capitalizes on the child's motivation in a naturalistic setting in order to teach language and other areas of functioning (R. L. Koegel et al., 1998). Originally referred to as the natural language paradigm (see R. L. Koegel, O'Dell, & Koegel, 1987), this approach uses child-selected stimuli and reinforces verbal attempts, as well as correct productions, with natural consequences to affect pivotal areas (e.g., joint attention, self-monitoring), thereby resulting in substantial collateral gains in the development of other critical skill areas (Simpson et al., 2005). Parental involvement is a key element of this approach (L. K. Koegel, Koegel, & Carter, 1998).

Research comparing PRT with ABA methods has demonstrated that this naturalistic approach results in greater functional communication than that of traditional behavioral approaches (R. L. Koegel et al., 1998) and so may be considered an empirically based practice (Simpson et al., 2005). However, more recent studies have focused on identifying the effectiveness of PRT for subgroups of children with ASD (Sherer & Schreibman, 2005) and applying PRT to improving joint attention (E. A. Jones, Carr, & Feeley, 2006; Whalen & Schreibman, 2003).

Sherer and Schreibman (2005) addressed the variability of treatment outcomes among children with ASD and argued for identifying factors that affect the efficacy of particular treatments. Findings from their retrospective analysis of pretreatment assessment data suggest that children who demonstrated exceptional responses to PRT were also those who initially had a moderate to strong interest in toys, a likewise tolerance of others in close proximity, and higher rates of verbal self-stimulatory behavior with concurrent lower rates of nonverbal self-stimulation. Sherer and Schreibman then successfully predicted the likely responders and nonresponders from a second group of children with ASD who had not yet received PRT. These findings suggest that profiles based on pretreatment characteristics may be used to predict responsiveness to PRT for some children with ASD. The researchers also noted that as a child's behavioral characteristics change over time (owing to development or intervention), different treatment approaches may need to be considered.

Like Kasari et al. (2006), Whalen and Schreibman (2003) employed naturalistic behavioral methods to target joint attention skills, but in this case they used PRT (with limited aspects of discrete trial training). The treatment targets were protodeclarative joint attention skills (i.e., use of bids for showing or sharing). For all five participants, positive changes were observed in responses to the joint attention bids of others, changes that were maintained by three children at a 3-month follow-up. Furthermore, all four participants that completed the initiation training phase of the treatment demonstrated improvements in initiating joint attention following treatment; however, these gains were maintained by only one child at 3-month follow-up. Probes indicate that all four children generalized both responding and initiating behaviors in a naturalistic setting with the experimenter, but findings for generalization with the children's mothers are mixed. Moreover, results indicate significant improvements in the normalcy of behaviors during playtime, based on ratings by naïve judges.

E. A. Jones et al. (2006) extended the work of Whalen and Schreibman (2003) to target joint attention skills in the natural environments of young children (i.e., home and preschool). Although all five participants were able to achieve mastery of the target behaviors, variability among the children was observed in terms of the number of sessions required to meet the goals. As well, more time was required for participants to master initiation than responding skills. Evidence for maintenance of acquired skills and generalization to a large number of novel toys and routines were reported. In addition, the findings suggest that some children were able to master responding and initiating behaviors with their parents in natural settings in fewer trials than in the original intervention with their preschool teachers. A post hoc language analysis of videotaped recordings indicated an increased number and variety of phonemes and words produced over time for all participants. The authors suggested that this increase in spontaneous verbalizations supports the hypothesis that development of joint attention facilitates development in other areas, such as expressive language. Furthermore, naïve judges rated the children as "appearing more like a typically developing young child" following intervention (E. A. Jones et al., 2006, p. 821), as compared at baseline.

Summary. The aforementioned studies (e.g., E. A. Jones et al., 2006; Kasari et al., 2006; Whalen & Schreibman, 2003) provide a measure of support for using naturalistic behavioral treatment methods to teach communication-related skills such as joint attention, symbolic play, turn

taking, requesting, and spontaneous verbalizations to children with autism. Using Robey's five-phase model of efficacy research (2004), all three studies examining milieu teaching qualify as clinical trials, thereby providing evidence for the efficacy of this approach (Kasari et al., 2006; Yoder & Stone, 2006a, 2006b). Studies of functional communication training, however, remain in an earlier phase of research to date, consisting exclusively of single-subject designs. Last, research on the use of PRT has advanced to the level of demonstrating effectiveness of PRT for a specific subgroup of children with autism (i.e., Sherer & Schreibman, 2005), while providing early-phase evidence for the application of PRT to joint attention training (E. A. Jones et al., 2006; Whalen & Schreibman, 2003).

The studies reviewed in this article regarding milieu teaching and PRT offer compelling clinical implications. Joint attention, which some consider pivotal (see E. A. Jones et al., 2006) in the acquisition of other communicative abilities (e.g., expressive language, social pragmatics), was addressed by a majority of the studies reviewed (i.e., E. A. Jones et al., 2006; Kasari et al., 2006; Whalen & Schreibman, 2003; Yoder & Stone, 2006a), thus demonstrating that using naturally occurring opportunities, naturalistic consequences, and environmental manipulation may facilitate the acquisition of correct responding to the joint attention bids of others, as well as the initiation of joint attention by the child with autism. Also, naturalistic behavioral methods were effectively used in both clinical and natural settings and can thus be administered by trained teachers and parents, as well as clinicians, thereby enhancing generalization. Finally, because it may be possible to predict responsiveness to treatment for some children with autism (Sherer & Schreibman, 2005), periodic examination of a child's behavioral characteristics may both broaden treatment options and allow for greater effectiveness of a treatment being applied.

Developmental Interventions

Based on theories of child development, developmental interventions include the following: floortime techniques (developmental, individual difference, and relationship based; Greenspan & Wieder, 2006); the social communication, emotional regulation, and transactional support model (Prizant, Wetherby, Rubin, & Laurent, 2003); and the Hanen approach (Sussman, 2002). Developmental interventions assume that language development is cultivated by strong, positive adult-child interactions; thus, parental training and involvement are integral to these treatment methods.

Although similar to naturalistic behavioral approaches, developmental interventions differ from naturalistic behavioral approaches in several ways. First, they focus on the function of social communication rather than on specific communication forms. Second, the child's verbal productions are not directly elicited in developmental interventions. Rather, all communicative attempts by the child, including those that are "pre-intentional and nonconventional" (Ingersoll, Dvortcsak, Whalen, & Sikora, 2005, p. 214), are responded to as being purposeful. Last, unlike naturalistic approaches, developmental approaches such as the floortime techniques have limited empirical support (Simpson et al., 2005), and their use is frequently justified on theoretical grounds alone (Ingersoll et al., 2005).

Given the importance of the role of caregivers in developmental approaches to communication treatment for children with ASD, it is not surprising that the focus of two recently published articles (Aldred, Green, & Adams, 2004; Mahoney & Perales, 2003) was that of teaching parents to be more sensitive and responsive to their children's communication attempts, thereby increasing the social interactions available to their children for developing language.

Mahoney and Perales (2003) employed a quasi-experimental pre- and postgroup design to explore what effects a parent-based, relationship-focused developmental intervention has on the social interactive behavior of young children with autism or pervasive developmental disorder—not otherwise specified. The authors reported significant improvements in children's overall social interactive behavior, as well as significant changes in attention, persistence, interest, cooperation, initiation, joint attention, affect, and socioemotional functioning. In addition, positive changes in maternal responsiveness appeared to account for a significant amount of the improvement in children's social interactive behavior.

In a randomized control study that improved on the design of Mahoney and Perales (2003), Aldred et al. (2004) trained parents to be highly sensitive to their children's actions, treating them as intentional and communicative. As the authors predicted, the developmental treatment resulted in a significant overall decrease in autistic symptoms for the treatment group, when compared with the control group. Furthermore, parents of children in the treatment group reported a significant increase in the frequency and quality of expressive communication, as opposed to no significant change in the control group. This finding was especially noteworthy among young children who were classified as being low functioning at baseline. Curiously, no significant increase in joint attention was seen in the treatment

group, despite improvements in reciprocal social interactions. The authors suggested that the manner in which parents adjusted their communicative behavior to meet their children's needs was a more sensitive indicator of improvements in the children's communication, as opposed to joint attention.

Ingersoll et al. (2005) examined the impact of their center-based developmental intervention on the expressive language of young children with autism in interactions with both clinicians and parents. The intervention included methods derived from social communication, emotional regulation, and transactional support, Hanen, and the floortime techniques. Two of the three boys showed generalization of spontaneous language use with their parents, in addition to maintaining higher rates of expressive language at a 1-month follow-up. Of particular note, a child who was nonverbal before treatment demonstrated improvement in spontaneous language use following the intervention. According to Ingersoll et al., this finding supports the use of less-structured developmental methods with nonverbal children, contrary to the suggestion by others that nonverbal children should master imitation skills via more structured methods before developmental interventions are employed.

Summary. Current findings—particularly, those of Aldred and colleagues' randomized control trial (2004)—lend support for the efficacy of parent-based developmental interventions. Furthermore, results from a single-subject study suggest that developmental methods may improve the expressive language skills of young children with autism, including those who are nonverbal (Ingersoll et al., 2005).

Several clinical implications based on the work of Mahoney and Perales (2003), Aldred et al. (2004), and Ingersoll et al. (2005) should be mentioned. First, evidence suggests that improving maternal sensitivity to the communication attempts of young children with ASD may result in clinically significant improvements in the social interactive behaviors of these children (Aldred et al., 2004; Mahoney & Perales, 2003). Such indirect treatment methods may offer a cost-effective alternative to expensive, intensive, clinician-provided, early intervention methods; however, studies are needed to investigate the cost-effectiveness of these methods. In addition, young children who are classified as low-functioning may benefit from parent-based developmental interventions, in contrast to behavioral methods (e.g., PRT), which, as reported earlier, appear to be most beneficial for young children who are higher functioning (Sherer & Schreibman, 2005; Stoelb et al., 2004). Last, contrary to

previous suggestions, joint attention may not be a sensitive predictor of treatment outcome (Aldred et al., 2004). Rather, the level of synchronicity in parent-child interactions may better predict treatment-related improvements, further underscoring the importance of maternal sensitivity.

Classroom-Based Interventions

Clinicians have long recognized the potential of school classroom settings as a natural environment for providing language learning opportunities for children with ASD. Consequently, several of the approaches previously addressed (e.g., ABA, milieu teaching, functional communication training, PRT) are frequently administered in special education classes. In addition, interventions have been developed for use in the classroom, such as TEACCH (Treatment and Education of Autistic and Related Communication-Handicapped Children) and Project DATA (Developmentally Appropriate Treatment for Autism), and are regularly employed to target communication goals.

TEACCH (see Schopler, 1994) attempts to compensate for the core deficits of children with ASD by incorporating structure, consistency, and continuous intervention in carefully designed environments (Panerai, Ferrante, & Zingale, 2002). Capitalizing on the visual preference of many children with ASD, TEACCH uses picture schedules, clearly labeled physical spaces for activities, and visual charts where complex tasks are broken into simple concrete steps. TEACCH is individualized for children in the special education classroom, as well as in other natural settings, and so aims to facilitate independence and autonomy by providing dependable structure and support. Functional communication is emphasized, with augmentative and alternative methods made available to nonverbal children and with incidental teaching used to facilitate meaningful communication skills (Mesibov, 1997).

According to Panerai et al. (2002), TEACCH "is one of the most valid treatment programs" (p. 319), based on studies examining its effectiveness in improving IQ, decreasing self-injurious behavior, and transitioning adults with autism into the workforce. However, few studies investigating the application of TEACCH methods to communicative outcomes met the criteria for inclusion in this study, and reports of improved outcome were based on parent responses to questionnaires and anecdotal evidence (Mesibov, 1997). Panerai et al. found that children in a TEACCH-based residential program gained more on outcome measures than did those in an

integrated public school class. These severely affected children demonstrated improvements in imitation, perception and motor skills, cognitive performance, play and leisure, and daily living skills. However, significant improvements in receptive and expressive communication abilities were not identified, which is consistent with earlier TEACCH research (see Goldstein, 2002).

Another classroom-based intervention, Project DATA, is intended exclusively for young children. Drawing from both developmental and behavioral models, this intervention integrates the family-centered, developmentally appropriate facets of early intervention programs with the intensive, explicit methods of traditional ABA (Boulware, Schwartz, Sandall, & McBride, 2006). The result is a program where young children with autism gain access to an inclusive early childhood classroom, along with the extended instructional time required for more intensive intervention (Schwartz, Sandall, McBride, & Boulware, 2004). Parents are provided with technical and social support, and services are coordinated among providers and the family, including a resource coordinator who assists children and families with transition issues as the children enter elementary school.

Schwartz et al. (2004) found that following 1 year at a Project DATA preschool, their 48 participants demonstrated improvements in all areas—especially, functional skills (i.e., receptive language, motor imitation, and toilet training) and developmental domains (i.e., adaptive behavior, social communication, and fine motor skills). A similar study by these same authors examined the effects of Project DATA for Toddlers on a group of eight very young children and found accelerated mental development during the treatment phase, along with improved self-regulatory behavior, communication abilities, and functional outcomes following treatment (Boulware et al., 2006). However, no control groups were included in these studies, so maturation cannot be ruled out as an explanatory factor.

Summary. The state of the current evidence for classroom-based methods (i.e., TEACCH and Project DATA) is limited and exploratory, which is surprising given the longevity and widespread use of programs such as TEACCH. Because of the limitations of the current research base, determining the efficacy of these approaches for addressing communication is somewhat difficult.

Video Modeling

Many of the treatment approaches described thus far utilize adults and, occasionally, peers as behavioral

models for children with ASD. However, many children with autism cannot effectively attend to the salient behaviors of others during live modeling, or they may find social interaction during an observational learning session anxiety inducing (Bellini & Akullian, 2007). Video modeling offers an alternative to classic modeling methods by capitalizing on the visual preference of children with autism while removing distressing or distracting elements from the treatment session, thereby increasing the children's attention to the behavior or skill being modeled (Bellini & Akullian, 2007).

Video modeling may incorporate other people (i.e., peers, siblings, or adults) as videotaped models of a target behavior or skill. Alternatively, in video self-modeling, the target child serves as his or her own model, which is motivating and useful for children who enjoy watching themselves on television (Bellini, Akullian, & Hopf, 2007). A third approach to video modeling, called *point-of-view modeling*, involves showing a target behavior from the perspective of the child who will be imitating the behavior (e.g., showing only a pair of hands using toy dishes appropriately, instead of displaying the model's entire body). According to Hine and Wolery (2006), video modeling typically consists of several features:

- Videotaped images are edited to focus on the target behavior or skill.
- The child watches repeated clips of the target behavior on a monitor.
- After viewing the videotape, the child practices or role-plays the behavior or skill with the clinician.
- Generalization of the behavior or skill is assessed (i.e., to other people, settings, or materials).
- The child repeats observation of the videotapes, as necessary.

Odom and colleagues' review (2003) of evidence-based practices for young children with ASD considered videotaped modeling to be "probably efficacious" (p. 173). More recently published works lend support for the use of videotaped modeling with children of all ages (Bellini & Akullian, 2007; Bellini, Akullian, et al., 2007; Hine & Wolery, 2006; Kroeger, Schultz, & Newsom, 2007). In a meta-analysis, Bellini and Akullian (2007) examined evidence for the efficacy of video modeling and video self-modeling interventions targeting social communication (e.g., conversation, social initiation and response, play), functional skills (e.g., hygiene, self-care), and behavior functioning (e.g., reduction in problem behavior) for children and adolescents with ASD. Their study found moderate effects for the intervention, as well as maintenance and generalization, which according to the

authors, support the effectiveness of video modeling and video self-modeling interventions. Furthermore, no age-related treatment differences were found, nor was video modeling versus video self-modeling shown to be more efficacious.

According to Bellini, Akullian, et al. (2007), many of the studies included in the aforementioned meta-analysis did not control for the potentially confounding effects of other concurrent treatments. Consequently, in their investigation of the effects of video self-modeling on social engagement, Bellini, Akullian, et al. ensured that the treatment effects were due to video self-modeling alone by instructing preschool teachers of the study participants not to prompt, cue, or provide direct instruction pertaining to social engagement during the study period. During treatment, the two participants viewed video self-modeling videotapes of themselves socially interacting with same-age peers, with all hidden supports (i.e., adult prompting and direction) having been cut. This study indicated that video self-modeling resulted in sizable improvements in unprompted social behaviors (e.g., active participation in activity with others, play, cooperative exchange of toys) for the two participants, with maintenance of these gains after the video self-modeling was withdrawn.

Additional support for video modeling comes from a study comparing it with a play-based intervention (Kroeger et al., 2007). Although significant improvements in social behaviors were found for both treatment groups (i.e., initiations, responses, interactions), this change was significantly more pronounced in the video-modeling group. Furthermore, video modeling was found to significantly increase the small-group learning skills of the participants.

Support for point-of-view modeling was found in a study by Hine and Wolery (2006), who used it to teach symbolic play actions to two young girls with autism. After watching the videotape, the girls spontaneously imitated many of the play behaviors shown in the video, without clinician reinforcement or prompting, and later generalized these behaviors to untrained materials and, to some extent, classroom settings. Social validation of these findings was supported by ratings of naïve judges, thus indicating increases in appropriate play following the point-of-view modeling intervention.

Summary. Findings from these studies provide evidence for the efficacy of video modeling and video self-modeling. Based on Robey's model (2004), Kroeger and colleagues' randomized group comparison (2007) provides evidence of treatment efficacy, whereas Bellini

and Akullian's meta-analysis (2007) represents a later-stage study of effect size across multiple studies, although no clinical trials were included in the meta-analysis. Furthermore, the other studies cited provide early-stage evidence for the application of video self-modeling to increasing social engagement in young children with limited verbal skills, as well as for the use of point-of-view video modeling to teaching play behaviors to young children. The clinical utility of these intervention methods is apparent when one considers the efficiency of video modeling, as well as the range of settings and skills for which video modeling may be applied. Videotapes can be replayed as many times as needed with minimal involvement on the part of teachers or clinicians and oftentimes, they may be reused with other children.

Social Skills Interventions

Several available interventions focus primarily on social and relationship skills. Past literature reviews have reported evidence that such treatments may improve specific social skills (e.g., initiations, responses), as well as general social functioning (McConnell, 2002; Rogers, 2000). Yet a recent meta-analysis of studies published between 1986 and 2005 (Bellini, Peters, Benner, & Hopf, 2007) concluded that school-based social skills interventions may be only minimally effective at addressing the social skills deficits of children with ASD.

Social skills training. Social skills training aims to teach individuals with ASD skills that are critical to successful social and emotional functioning, and it focuses on perspective taking, conversational skills, problem solving, emotional awareness and regulation, and the unwritten rules of social engagement (Barnhill, 2002). Frequently used methods include modeling, coaching, social scripts, and written cueing. Furthermore, many social skills curricula have been published (Baker, 2003; McGinnis & Goldstein, 1997; Myles, Trautman, & Schelvan, 2004; Winner, 2002). According to Lopata, Thomeer, Volker, and Nida (2006), many of these methods are based on cognitive techniques using direct teaching of social skills and strategies.

Previous research has demonstrated that children with ASD may be taught scripted social interactions (Goldstein, 2002). However, after reviewing studies published through 1998, Simpson et al. (2005) concluded that the supporting evidence for the use of cognitive-based scripts is limited. A more recent study by Charlop-Christy and Kelso (2003) introduced conversational scripts on cue cards to elementary school-age boys to

teach appropriate conversation skills, such as turn taking, asking questions, and appropriate responding. They found that all three boys were able to rapidly meet the testing criteria (i.e., 100% correct responding) and maintain these skills even after the cue cards were removed. Evidence of generalization to untrained topics, setting, and person was also reported. The authors suggested that this approach may be particularly well suited for children with ASD who have a predilection for reading.

Webb, Miller, Pierce, Strawser, and Jones (2004) studied the use of direct instruction via the SCORE Skills Strategy program (i.e., share ideas, compliment, offer help, recommend changes, exercise self-control) and reported that with the exception of sharing ideas, the 10 teen participants significantly increased their performance of the targeted skills. They also demonstrated a significantly improved knowledge of these skills and an ability to discriminate situations in which these skills are to be used. However, the outcome measures for this study were directly tied to the treatment program's curriculum. Furthermore, parent ratings of each child's social skills did not show a significant increase following treatment.

These findings are consistent with those of Lopata et al. (2006), who suggested that cognitive-based social skills instruction alone is not sufficient to improve overall social skill abilities for children with high-functioning autism but that behavioral techniques may be required to provide structure and reinforcement for prosocial behaviors while decreasing negative ones. According to McGinnis and Goldstein (1997), Skillstreaming incorporates both cognitive and behavioral components in teaching social skills. Lopata et al. (2006) found that their social skills treatment—which included Skillstreaming, face-affect recognition, cooperative and interest-expansion activities, and naturalistic behavioral feedback/reinforcement—resulted in significant increases in social skills (based on parent and staff ratings) for children with Asperger syndrome.

Social stories. Because traditional social skills training often involves role-playing and other socially interactive activities, individuals with ASD may consider these approaches to be aversive and objectionable. Social stories (a commonly used form of social skills instruction) present the same information in a less threatening format (Sansosti & Powell-Smith, 2006). Social stories are written narratives developed by trained parents and professionals to improve the social understanding of individuals with ASD by providing them with explicit developmentally appropriate information regarding the

rules and expectations for specific situations and troublesome social scenarios (Gray, 2000). Social stories are characterized by four types of sentences: descriptive, perspective, directive, and affirmative. Social stories may be read daily or just before the targeted situation (to prime the child), and they are faded as the targeted behaviors and skills are mastered.

Two separate reviews investigated the evidence for the use of social stories to reduce negative behaviors (e.g., shouting, tantrums, obsessive behaviors) and promote skills such as social communication, self-help, and compliance (Ali & Frederickson, 2006; Sansosti, Powell-Smith, & Kincaid, 2004). Both reviews concluded that evidence for the effectiveness of social stories was limited by weaknesses in study design (e.g., no experimental controls, confounding variables, modest changes in targeted behaviors), and both suggested the need to investigate generalizability and maintenance. Simpson et al. (2005) also concluded that social stories were promising but that further research was needed.

More recent studies (i.e., Sansosti & Powell-Smith, 2006; Scattone, Tingstrom, & Wilczynski, 2006) continue to offer only limited support for the use of social stories to improve the social behavior of children with ASD. Sansosti and Powell-Smith (2006) introduced social stories to three males with Asperger syndrome to improve their social engagement with peers. Improvement was seen for two of the three participants, but no maintenance of these skills was found at 2-week follow-up. Likewise, Scattone et al. (2006) developed individualized social stories to teach initiation and response behaviors to three boys with ASD and found improved social interactions with peers for two children. However, further analysis (based on the percentage of non-overlapping data points) indicated that the treatment was highly effective for only one child.

Despite their widespread use, current findings do not yet support the efficacy of social stories. They do, however, shed light on several important clinical factors. First, having the child read the social story, as opposed to listening to the reading by a teacher or parent, may result in greater improvement in social behavior, particularly if the child has an affinity for reading (Scattone et al., 2006). Second, targeting social skills that the child has demonstrated, even if infrequently, may be preferable to teaching entirely new social skills via social story, especially if the child is lacking the social awareness to monitor behavior. Last, feedback and reinforcement for using targeted skills, especially at the beginning of treatment, may increase the effectiveness of social stories (Sansosti & Powell-Smith, 2006).

Peer/sibling training. Although to date the evidence for social skills training and social stories remains limited, peer-mediated interventions have been described as “emerging and effective” (Odom et al., 2003, p. 172). Peer-based methods, which are well developed and widely used, capitalize on peer interactions to teach appropriate social-communicative behaviors (McConnell, 2002). Through direct instruction, adult modeling, and prompt/reinforcement, peers are taught to facilitate social interactions with children who have ASD, much like the parent-directed methods previously discussed. Furthermore, siblings, as a subset of peers, may be taught to increase and support the social behaviors of their brothers and sisters with ASD (Tsao & Odom, 2006).

In perhaps the largest study of peer-mediated ASD treatment to date, Kamps et al. (2002) investigated the effects of concomitant peer and target-child social skills training and found an increase in the duration and frequency of social interactions for children with ASD during the intervention period. And although duration of social interaction was significantly greater when children with ASD were paired with trained peers (rather than untrained peers), the second phase of their study found evidence for the generalization of these skills with untrained familiar peers.

Despite evidence for improvements in general social functioning following peer training, Thiemann and Goldstein (2004) argued that peer-mediated intervention alone may be insufficient to produce changes in social skills. Their study examined the consecutive implementation of two social interventions (i.e., peer training and written text cueing) and found that although two of the five participants demonstrated improved overall social interaction rates following peer training, all five continued to show deficits in social skills (e.g., initiating requests, comments, compliments, topic maintenance). Following written text cueing, however, four out of five children showed increased initiations, and all children demonstrated improved topic maintenance. These skills were maintained during short-term follow-up probes. Furthermore, social validity ratings of pre- and posttreatment videotapes by naïve raters indicated improvements for all five children in terms of their social interactions with peers.

As mentioned, siblings are a logical choice for peer training because children with ASD most likely have greater social exposure and opportunities for interaction in many more settings (e.g., home, community, etc.) with their siblings than with other peers. Tsao and Odom (2006) taught skills to the siblings of four preschoolers to facilitate social engagement—for example, making eye contact, moving in closer proximity, expanding the target child’s verbalizations.

Although only modest improvements in the social interactions were reported for three sibling–target child dyads, clear increases in joint attention for three of the target children were discovered, as were improvements in responding to sibling initiations. Social validity of these findings was confirmed using naïve coders, who indicated improvements in the quality and social aspects of sibling–target child play. However, generalization of these improvements to other natural settings was not demonstrated. Also, the training appeared to decrease the social interaction between one dyad, in which the sibling was quite older than the target child, thus suggesting that age differences between siblings, as well as the complexity of sibling relationships, should be considered before introducing this treatment approach.

Findings from the studies of Kamps et al. (2002), Thiemann and Goldstein (2004), and Tsao and Odom (2006) suggest that peer training may improve the social behavior of some children with ASD. However, expansion of these effects beyond general social functioning to specific social skills may require additional methods, such as directed teaching or written text cueing. Clinical benefits of peer-mediated interventions include its potential for generalization and maintenance, given the intensive and naturalistic elements of this approach (i.e., peers of school-age children with ASD have greater contact in social situations than do teachers and parents). Future studies should examine how the characteristics of peers (e.g., age, gender, relationship to the target child), along with variables associated with the social development of children with ASD, may affect the efficacy of peer-mediated interventions, as well as the generalization and maintenance of such effects.

Summary. The evidence regarding social skills interventions (i.e., social skills training, social stories, peer/sibling training) remains in an earlier stage of investigation relative to the scheme of Robey (2004). In particular, studies of social skills training are exploratory but do suggest considerable promise, particularly when coupled with behavioral components. Evidence for the efficacy of social stories remains limited, with no clear support for the maintenance of treatment-based improvements, despite the pervasive use of social stories by clinicians and educators of children with autism. However, support for peer-mediated interventions is supported by more than 20 years of clinical research, although this support is based largely on single-subject studies and it lacks clinical trials or controlled group designs. More research is clearly warranted.

Augmentative and Alternative Communication

According to Simpson et al. (2005), half of all children with ASD will remain nonverbal, underscoring the importance of providing nonspeech communication methods for this population. Augmentative and alternative communication (AAC) methods are suitable for use with individuals of a range of ages and levels of cognitive functioning (Simpson et al. 2005). Capitalizing on the visual strength and preference of many children with ASD, some frequently used AAC methods include aided symbols (e.g., PECS; Bondy & Frost, 1994), speech-generating devices, and manual signing.

Mirenda (2001) reviewed studies published through 1999 that examined the functional interactive use of aided AAC symbols with individuals who have autism and subsequently presented empirical findings in four areas: augmented input (e.g., visual schedules, symbols for choice making), augmented input and output (e.g., aided language stimulation, system for augmenting language), augmented output only (e.g., visual-spatial symbols, PECS), and assistive technology for communication and learning (e.g., speech-generating devices, computer-assisted instruction). Mirenda found substantial evidence for the use of visual schedules, a system for augmenting language, and visual-spatial symbols but limited empirical support for more commonly used methods (i.e., PECS, symbols for choice making, and aided language stimulation). Furthermore, Mirenda reported that a majority of clinicians and parents using AAC with children who had autism did not feel competent with regard to their ability to provide AAC supports.

PECS. PECS (Bondy & Frost, 1994), a “structured behavioral intervention system designed to teach the use of visual-graphic symbols for communication” (Mirenda, 2001, p. 145), is widely utilized with children who have ASD, particularly in school settings. Children are taught to use cards printed with aided Picture Communication Symbols (Mayer-Johnson, 1992) to communicate their wants or needs. In addition, PECS is used to teach children with ASD communicative intent beyond requesting (e.g., commenting), and it can be utilized to expand a child’s vocabulary skills by teaching object-to-picture correspondence for a range of items (Bondy & Frost, 1994). PECS cards are initially presented to the child as a limited set that is expanded as the child’s repertoire develops. Instruction occurs in phases, moving from the basic exchange of cards, to acquiring the attention of communication partners and discriminating among

multiple cards, to ultimately forming sentences and answering questions with cards (Simpson et al., 2005). The goal for this population is that PECS will eventually lead to the development of verbal communication, given that some level of functional communication has been acquired (Schwartz, Garfinkle, & Bauer, 1998).

A review of studies published through 2004 concluded that the state of efficacy research for PECS was limited but promising (Simpson et al., 2005). However, more recent group studies of PECS with children who have ASD are available. Carr and Felce (2007) found that after 15 hr of PECS training, children in the treatment group significantly increased initiations to their teachers, as well as responses to their teachers’ initiations. In addition, the children receiving PECS training demonstrated significantly more initiations and responses than did the control group. Similarly, Yoder and Stone (2006a) found that PECS training resulted in significantly greater requesting for young nonverbal children with limited pretreatment joint attention skills, as compared to children receiving a prelinguistic milieu intervention. These findings are in agreement with those from earlier single-subject studies (Charlop-Christy, Carpenter, Le, LeBlanc, & Kelley, 2002; Ganz & Simpson, 2004) that demonstrated improved initiating and requesting skills following PECS training.

Some other studies provide evidence for the use of PECS and Picture Communication Symbols beyond basic initiating and requesting behaviors and in nonschool settings. Markel, Neef, and Ferreri (2006) explored teaching two preschool-age boys to improvise while requesting untrained objects. After the intervention, both boys used novel combinations of PECS cards to produce mands, and they generalized this skill to naturalistic settings. Furthermore, a study by Nunes and Hanline (2007) found support for the feasibility of implementing a naturalistic intervention using PECS in the home. Following this parent-administered treatment, the target child demonstrated increased initiating and requesting behaviors during typical caregiving routines.

Additional evidence has suggested that PECS may facilitate the acquisition of speech. Charlop-Christy et al. (2002) found increases in verbalizations following PECS training for all three of their study participants. Likewise, Ganz and Simpson (2004) reported increased verbal output of longer and greater complexity following PECS training for children who started the study with limited or nonexistent verbal skills. The most convincing support for this PECS outcome comes from a study by Yoder and Stone (2006b), which demonstrated a significantly greater number of non-imitative verbal communication

acts of significantly more diversity following PECS training, as compared with a prelinguistic milieu intervention. These findings were particularly evident among young children who demonstrated high pretreatment object exploration rates. Charlop-Christy et al. suggested that the development of speech following PECS training might be due to the functional nature of the intervention (i.e., focus on requesting as opposed to labeling), simultaneous pairing of picture and spoken phrase by the teacher or clinician (e.g., "I want ball"), and use of delayed verbal modeling.

Many children who have mastered PECS remain nonverbal, however. For these individuals, Simpson et al. (2005) recommended introducing a speech-generating device to enhance their communication abilities, although to date, no published studies have investigated the use of speech-generating devices in this population for communication beyond basic spelling skills (Mirenda, 2003). Accordingly, given the language and social deficits that characterize autism, merely providing a means of communication does not, in and of itself, appear to give the individual with ASD the ability to communicate (Beukelman & Mirenda, 2005).

Sign language training. Although PECS is a more recently developed intervention, sign language training has been successfully used for decades to teach expressive and receptive vocabulary to children with autism (Goldstein, 2002; Mirenda, 2003). Specifically, studies have shown that sign or total communication (i.e., simultaneous presentation of sign and spoken words) has resulted in a more rapid acquisition of vocabulary than that by training with speech alone, especially for individuals with limited verbal imitation skills (Goldstein, 2002). For example, a recent study by Carbone et al. (2006) demonstrated the superiority of total communication training over speech training alone in the acquisition of picture labels.

Summary. A growing body of research supports the use of AAC methods for children with ASD. Specifically, the state of the evidence for PECS has risen to the level of empirically demonstrated efficacy (Carr & Felce, 2007; Yoder & Stone, 2006a, 2006b), with some evidence of effectiveness for specific applications of PECS (Markel et al., 2006; Nunes & Hanline, 2007). Furthermore, scientific evidence exists for the efficacy of PECS in facilitating speech development (Yoder & Stone, 2006b). Likewise, the use of sign language training (over speech alone) has received strong empirical support through the years (Carbone et al., 2006; Goldstein, 2002; Mirenda, 2003); however, research comparing sign language training to other

treatment methods is quite limited, with mixed findings (Mirenda, 2003; Tincani, 2004).

Given the prevalence of children with ASD who are nonverbal or have limited verbal skills, findings pertaining to the use of AAC methods are clinically relevant, and more research is needed. We do appear to have identified several important factors thus far. First, joint attention skills do not appear to be a prerequisite to beginning PECS training, as they are for other treatment approaches (Yoder & Stone, 2006a). Also, significant improvements in communicative behaviors may be observed in as little as 15 hr of PECS training (Carr & Felce, 2007), compared with dozens to hundreds of hours of behavioral discrimination training. Next, both PECS and sign language training foster speech acquisition in nonverbal children with ASD, probably owing to the visual nature and functional approach of these methods (Carbone et al., 2006; Yoder & Stone, 2006b). Finally, individual characteristics (e.g., fine motor dexterity, age, level of object exploration) should be considered when selecting appropriate AAC methods for nonverbal children with AAC.

Discussion

A decade ago, the first published review of studies investigating autism treatment declared that research had not yet reached the level of scientifically demonstrated efficacy (Rogers, 1998). Since that time, however, additional literature has provided clinicians and educators with empirical support for several interventions with this population. Examining 36 studies published between 2002 and 2007, we found mixed results across treatment categories. On one hand, solid evidence is now available for the efficacy of several interventions, including ABA, naturalistic behavioral (i.e., milieu and PRT), developmental, video modeling, and AAC; furthermore, research supports the effectiveness of ABA, PRT, and PECS under certain procedural variations and among particular subgroups of children with ASD. On the other hand, interventions remaining in an exploratory stage of investigation included classroom-based treatments, social skills interventions, and one naturalistic behavioral approach (i.e., functional communication treatment).

Limitations of the Current Review

Before discussing the application of these findings to clinical practice, several limitations of the current literature base should be addressed. First, disparities among studies—in terms of outcome variables studied and the manner in which these variables are operationally defined—renders

direct comparison of findings problematic. Second, the majority of the studies investigating communication-based treatments for ASD employed single-subject designs rather than randomized controlled trials, which are considered the gold standard of clinical efficacy research (see Robey, 2004). Third, few studies have compared treatment approaches. Last, research in the field of autism intervention has not yet advanced to the level of investigating the cost-effectiveness of treatments, even though in the United States alone, an estimated \$35 billion is spent each year on interventions for ASD (Ganz, 2006). Limitations notwithstanding, current research offers compelling implications for the evidence-based practice of professionals who work with children with ASD.

Implications for Clinical Practice

Given the heterogeneity among individuals with ASD, understanding a child's profile of abilities and deficits is critical to the selection of appropriate treatment methods. Fortunately, recent studies (e.g., Aldred et al., 2004; Ingersoll et al., 2005; Sherer & Schreibman, 2005; Stoelb et al., 2004; Yoder & Stone, 2006a, 2006b) have offered some clues to the effectiveness of specific interventions, given a child's pretreatment characteristics, such as age, verbal abilities, level of functioning, joint attention, history of symptom regression, and object exploration. For example, young nonverbal children with limited pretreatment joint attention skills may respond better to PECS training than to milieu training in terms of learning to request; yet, young nonverbal children with low levels of pretreatment object exploration may benefit more from milieu than PECS in terms of developing verbal skills (Yoder & Stone, 2006a, 2006b). It is important to note that these characteristics will typically change over time, thereby suggesting that the periodic evaluation of treatment suitability should be part of any successful treatment plan (Sherer & Schreibman, 2005).

Similarly, the literature has indicated that particular treatment methods need not be used to the exclusion of others and that a combination of approaches may prove advantageous for many children with ASD. For instance, total communication using either PECS or sign language, which has been shown to facilitate the development of verbal communication (Tincani, 2004), may be combined with some other efficacious intervention (e.g., PRT or a developmental treatment) to improve the communication skills of nonverbal children. Likewise, video modeling may be employed concomitantly with social skills training to target conversational skills in higher-functioning children. In addition, parents, peers, or siblings may serve

as models for target behaviors or may be trained to facilitate skill acquisition in children with ASD. Given the amount of contact and variety of settings in which children with ASD interact with these individuals, the potential exists for high-intensity treatment with frequent opportunities for generalizing and maintaining skills.

As a fundamental deficit among individuals with ASD, the lack of rigorous examination of social skills interventions is disappointing. Of course, the dynamic and complex nature of social interactions, along with the individual variation of social deficits among children with ASD, make such investigations difficult. Rogers (2000) suggested that we must first understand the norms of social engagement and then distinguish between social behaviors and aspects/features of relationships before we can improve the social functioning of individuals with ASD across the life span. Rethinking the way that we define, measure, and analyze social variables may thus improve the quality of evidence available for social skills interventions. In the meantime, other more validated methods for targeting social goals are available, such as video modeling and developmental interventions (see Aldred et al., 2004; Bellini & Akullian, 2007).

Future Directions

In conclusion, this is a promising time for clinicians and educators with a commitment to providing proven, effective treatment to children with ASD. The literature base now offers empirical evidence for well-established interventions, and with the signing of the Combating Autism Act of 2006, \$1 billion will be available to researchers over the next 5 years.

As research advances our understanding and management of ASD, several recommendations can be made to improve on the present literature base. First, future research should employ stronger methodological designs—preferably, controlled group studies—to bolster the quality of evidence. When the use of single-subject studies is unavoidable, researchers should ensure that their designs include some manner of experimental control (e.g., multiple baseline, alternating treatments, reversal designs), as well as methodological features that improve reliability and validity (e.g., treatment fidelity, social validity). In addition, a direct comparison of treatment methods for clinically important outcome variables would assist professionals to select appropriate interventions for individuals with ASD. Last, research must advance to the level of cost-effectiveness analysis, at least for treatments with empirically supported efficacy, to guide decisions regarding the public and private allocation of billions of dollars each year in the management of ASD.

Appendix: Summary of Studies Reviewed, by Treatment Category

Applied Behavior Analysis

REFERENCE: Eikeseth, Smith, Jahr, and Eldevik (2002)

PARTICIPANTS (*n*): Mild–moderate; 4–7 years (25)

STUDY DESIGN: Group comparison study (two groups)

INDEPENDENT VARIABLES: Treatment group • Intensive applied behavior analysis • Intensive eclectic treatment

DEPENDENT VARIABLES: IQ • Language functioning • Communication abilities • Socialization • Daily living skills • Adaptive behavior

RESULTS: More gains after 1 year for applied behavior analysis group • Significant improvements for applied behavior analysis group in IQ, language, adaptive behavior • Pretreatment IQ significant predictor of outcome for both groups • Age at onset of treatment a significant predictor for adaptive behavior outcome for eclectic group

STUDY LIMITATIONS: Excludes severe autism • Applied behavior analysis group includes parent involvement (eclectic group did not) • Use IQ as an outcome measure • Use of different measures, based on age • Use of Wechsler Intelligence Scale for Children to measure language

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

REFERENCE: Stoelb et al. (2004)

PARTICIPANTS (*n*): Mild–severe; 2–10 years (19)

STUDY DESIGN: Retrospective clinical chart review

INDEPENDENT VARIABLES: Age • Gender • Race • MRI results • Physical morphology • Autism classification • Presence of seizure or sleep disorder • History of symptom regression • Pretreatment functioning • Familial factors • Treatment intensity

DEPENDENT VARIABLES: Change in performance on composite score based on: • Vocal imitation • Motor imitation • Visual–motor skills • Receptive language • Expressive labeling • Social/conversational language • Play skills

RESULTS: Physical dysmorphology significantly predicted outcome at 6 and 12 months post-treatment onset (negative correlation) • History of symptom regression significantly predicted outcome at 12 months (negative correlation) • Younger children with pretreatment linguistic skills and no symptom regression had better overall outcomes

STUDY LIMITATIONS: Questionable fidelity of data source • Dependent measure lacked external validation • Raters not blind to independent variables

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Jones and Schwartz (2004)

PARTICIPANTS (*n*): 3–5 years (3)

STUDY DESIGN: Parallel treatment, single subject, counterbalance across three treatment sets

INDEPENDENT VARIABLES: Type of model: • Peer • Sibling • Adult

DEPENDENT VARIABLES: Verbal labeling in response to question • Maintenance

RESULTS: All participants reached criterion level with sibling and peer models for all stimuli sets • 1 child reached criterion level with adult model for all stimuli sets • Maintained higher response scores at follow-up • No consistent preference for one type of model

STUDY LIMITATIONS: Small *n* • No measure of generalization • Short follow-up period (2 weeks)

LEVEL OF EVIDENCE: Later-stage test of effectiveness under procedural variation

Naturalistic Behavioral Approaches

MILIEU TRAINING

REFERENCE: Kasari, Freeman, and Paparella (2006)

PARTICIPANTS (*n*): 3–4 years (58)

STUDY DESIGN: Randomized controlled trial (three groups)

INDEPENDENT VARIABLES: Group assignment: • Joint attention treatment • Symbolic play treatment • Control group

DEPENDENT VARIABLES: Joint attention (initiating and responding) • Functional play type • Symbolic play type • Play level

RESULTS: Joint attention treatment group significantly more initiation and responding than control group • Symbolic play group significantly greater level of play than that of control group and significantly greater use of symbolic play than that of joint attention treatment and control groups

(continued)

Appendix (continued)

STUDY LIMITATIONS: No follow-up

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

REFERENCE: Yoder and Stone (2006a)

PARTICIPANTS (*n*): Nonverbal; 1.5–5.0 years (36)

STUDY DESIGN: Randomized group comparison (two groups)

INDEPENDENT VARIABLES: Group assignment: • Responsive education and prelinguistic milieu teaching (RPMT) • Picture Exchange Communication System (PECS)

DEPENDENT VARIABLES: Frequencies: • Requesting • Initiating joint attention • Object exchange turns

RESULTS: RPMT group demonstrated significantly more object exchange turns than did PECS group • Children with some level of pretreatment initiating skills demonstrated significantly greater improvement in initiating joint attention and requesting in RPMT group than did PECS group

STUDY LIMITATIONS: Coders and examiners not blind to group assignment • No data reported separately for higher functioning children transitioned out of RPMT group

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

REFERENCE: Yoder and Stone (2006b)

PARTICIPANTS (*n*): Nonverbal; 1.5–5.0 years (36)

STUDY DESIGN: Randomized group comparison (two groups)

INDEPENDENT VARIABLES: Same as Yoder and Stone (2006a)

DEPENDENT VARIABLES: • Non-imitative communication acts • Number of different non-imitative words spoken • Object exploration

RESULTS: Those with low pretreatment levels of object exploration benefitted more from RPMT than PECS on number of non-imitative words 6 months later

STUDY LIMITATIONS: Same as Yoder and Stone (2006a)

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

FUNCTIONAL COMMUNICATION TRAINING

REFERENCE: Mancil, Conroy, Nakao, and Alter (2006)

PARTICIPANTS (*n*): 4-year-old with tantrums, limited language (1)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Home-based functional communication training for four mand conditions

DEPENDENT VARIABLES: Duration of tantrum • Latency to communication response • Number of spontaneous verbalizations

RESULTS: Tantrums declined by 90% for all mand conditions • Latency to respond decreased to a low and stable rate • Spontaneous utterances increased from 2 to 50 words from baseline to fourth condition, including two or three word combinations

STUDY LIMITATIONS: Only one participant • Observer/rater not blind to phase of treatment • No intrarater reliability reported • Measurements of spontaneous verbalizations collected anecdotally at conclusion of study • Generalization to other settings/partners not measured

LEVEL OF EVIDENCE: Exploratory, earlier stage

PIVOTAL RESPONSE TRAINING

REFERENCE: Sherer and Schreibman (2005)

PARTICIPANTS (*n*): Mild and severe; 3–5 years (6)

STUDY DESIGN: Multiple-baseline, matched-group comparison (two groups)

INDEPENDENT VARIABLES: Likelihood of responding to pivotal response training (PRT) treatment based on the following: • Toy contact • Approach behavior • Avoidance • Self-stimulatory behavior; Group assignment: • Predicted responders • Predicted nonresponders

DEPENDENT VARIABLES: Expressive language use • Play behavior • Social behavior

(continued)

Appendix (continued)

RESULTS: Predicted nonresponders showed no measurable progress following PRT • Predicted responders demonstrated gains in all areas following PRT and generalized to novel settings and stimuli

STUDY LIMITATIONS: Small *n* • Posttreatment measures taken at 5 weeks for nonresponders versus 6 months for responders • Dependent measures based on profile of variables but component analysis not reported

LEVEL OF EVIDENCE: Later stage study of effectiveness for specific subgroups

REFERENCE: Whalen and Schreibman (2003)

PARTICIPANTS (*n*): 4 years (5)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: University clinical lab-based PRT intervention targeting joint attention behaviors

DEPENDENT VARIABLES: Responding to joint attention bids of others • Initiating joint attention • Social validity "normalcy" ratings by naïve observers

RESULTS: Positive changes in responding to joint attention posttreatment and 3 months later • Increased initiation behavior posttreatment but limited maintenance 3 months later • Generalization to a naturalistic setting with experimenter • Mixed results for generalization to parents • Two of four children judged not significantly different from neurotypical peers at posttreatment

STUDY LIMITATIONS: Small *n* • Experimenters administering dependent measures not blind to study hypotheses • Generalization to naturalistic setting conducted in the clinic • Unclear whether children's initiations were truly "proto-declarative" or were "proto-imperative"

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Jones, Carr, and Feeley (2006)

PARTICIPANTS (*n*): 2–3 years (5)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: PRT and discrete trial training targeting initiating and responding to joint attention administered by • preschool teacher • parents

DEPENDENT VARIABLES: Responding to joint attention bids of others • Initiating joint attention bids • Spontaneous verbalizations • Social validity measure of social communication and play by naïve observers

RESULTS: Mastery of responding and initiating behaviors by all • Generalization and maintenance levels around 90% • More rapid acquisition of behaviors with parents at home • Increased spontaneous verbalizations during and after treatment • Judged more "typical" after treatment by naïve observers

STUDY LIMITATIONS: Coders not blind to treatment condition • Utilized parents as coders for home phase • Post hoc analysis of spontaneous verbalizations without controls

LEVEL OF EVIDENCE: Exploratory, earlier stage

Developmental Interventions

REFERENCE: Mahoney and Perales (2003)

PARTICIPANTS (*n*): 3–5 years (20)

STUDY DESIGN: Quasi-experimental pre- and postcomparison

INDEPENDENT VARIABLES: Parent-based, relationship-focused developmental intervention (pre- and poststatus) • Maternal interaction style (pre- and posttreatment)

DEPENDENT VARIABLES: Child's social interactive behavior based on raters blinded to pretreatment and posttreatment status

RESULTS: Significant overall improvement in child social interactive behavior • Positive changes in maternal interaction style accounted for 25% of child improvement (significant) • Significant improvement in child subscales (attention, persistence, interest, cooperation, initiation, joint attention, affect, and socioemotional functioning)

STUDY LIMITATIONS: No control group • Homogeneous convenience sample

LEVEL OF EVIDENCE: Exploratory, earliest stage

REFERENCE: Aldred, Green, and Adams (2004)

PARTICIPANTS (*n*): 2–6 years (28)

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Appendix (continued)

STUDY DESIGN: Randomized controlled trial (2 groups)

INDEPENDENT VARIABLES: Within-group pre- and postcomparisons • Group assignment: • Parent-based developmental/social treatment + “routine” treatment • Control group: “routine” treatment only

DEPENDENT VARIABLES: Autism symptoms • Parent–child social interactions • Social communication and language

RESULTS: Treatment group showed significantly reduced autism symptoms whereas control group did not • Treatment group showed significant increase in frequency and quality of expressive communication, especially younger, low-functioning kids • Treatment group: significant improvement in parent–child interactions

STUDY LIMITATIONS: Treatment group alone had time with a therapist (even though treatment was parent-based) • Significant findings for increase in expressive language were parent based

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

REFERENCE: Ingersoll, Dvortscsak, Whalen, and Sikora (2005)

PARTICIPANTS (*n*): 2–3 years (3)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Center-based developmental treatment combining methods from the social communication, emotional regulation, and transactional support model; floortime techniques (developmental, individual difference, relationship based); Hanen; and responsive teaching

DEPENDENT VARIABLES: Total appropriate language • Rate of spontaneous language

RESULTS: Improvements in spontaneous language use with clinician for all three • Increased appropriate language use with clinician and parent for all three • Generalization of spontaneous language use to interactions with parents for two of three • Maintenance of spontaneous language use with clinician at 1 month posttreatment for two participants

STUDY LIMITATIONS: Small *n* • Follow-up only 1 month posttreatment and data missing for one participant • Results for generalization to parents may be confounded • Maturation as a confounding variable cannot be excluded for one participant

LEVEL OF EVIDENCE: Exploratory, earlier stage

Classroom-Based Interventions

REFERENCE: Panerai, Ferrante, and Zingale (2002)

PARTICIPANTS (*n*): Severe, nonverbal; 6–14 years (16)

STUDY DESIGN: Matched group comparison study (two groups)

INDEPENDENT VARIABLES: Within-group pre- and postcomparisons • Group assignment: • Residential TEACCH (Treatment and Education of Autistic and Related Communication-Handicapped Children) • Integration in public school classroom (control group)

DEPENDENT VARIABLES: *Psycho-Educational Profile-Revised* • *Vineland Adaptive Behavior Scale*

RESULTS: Significant improvement on *Psycho-Educational Profile-Revised* for TEACCH group (i.e., cognitive performance, developmental age, imitation) • Significant improvement on *Vineland Adaptive Behavior Scale* for TEACCH group (i.e., overall, personal domain, daily living skills, play) • Only daily living skills on *Vineland Adaptive Behavior Scale* and hand–eye coordination on *Psycho-Educational Profile-Revised* were significantly improved for control group

STUDY LIMITATIONS: Small group sizes • Effects of TEACCH treatment may be confounded by residential status of participants who lived at treatment facility • Did not find communication improvements for either group

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Schwartz, Sandall, McBride, and Boulware (2004)

PARTICIPANTS (*n*): 3–6 years (48)

STUDY DESIGN: Quasi-experimental pre- and postgroup comparison

INDEPENDENT VARIABLES: Project DATA (Developmentally Appropriate Treatment for Autism), a university-based inclusive, developmentally appropriate preschool with supplementary training for parents

DEPENDENT VARIABLES: Functional skills: • Expressive/receptive language • Motor imitation • Toilet training • Play • Developmental domains: • Adaptive behavior • Cognitive • Social–communicative • Gross motor • Fine motor

RESULTS: Improvements in all outcome areas

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Appendix (continued)

STUDY LIMITATIONS: No control group • Cannot exclude maturation effect • Raters not blind to pre- and poststatus • Findings based on percentage who achieved preset levels, not comparison of actual scores

LEVEL OF EVIDENCE: Exploratory, earliest stage

REFERENCE: Boulware, Schwartz, Sandall, and McBride (2006)

PARTICIPANTS (*n*): 18–29 mos. (8)

STUDY DESIGN: Single subject, pre- and postcomparison

INDEPENDENT VARIABLES: Project DATA, a university-based inclusive, developmentally appropriate playgroup for toddlers with supplementary training for parents

DEPENDENT VARIABLES: Mental development • Temperament • Self-regulatory behavior • Communication and symbolic behavior • Functional outcomes (e.g., imitation, toileting, play)

RESULTS: Accelerated mental development during treatment for six of eight children • Improved self-regulatory behavior for four of eight • Improved communication abilities for six of eight • Improved functional outcomes for all eight

STUDY LIMITATIONS: Small *n* • Does not control for maturation effect for most outcome variables • Raters not blinded to pre- and poststatus

LEVEL OF EVIDENCE: Exploratory, earliest stage

Video Modeling

REFERENCE: Bellini and Akullian (2007)

PARTICIPANTS (*n*): 3–20 years (73)

STUDY DESIGN: Meta-analysis of 23 multiple baseline/reversal single-subject studies, 1987–2005

INDEPENDENT VARIABLES: Video modeling (VM) intervention • Video self-monitoring • Age

DEPENDENT VARIABLES: Social communication skills • Behavioral functioning • Functional skills

RESULTS: Moderate overall intervention effects for all dependent variables • Moderate effects for maintenance and generalization • No significant difference for effects between VM and video self-monitoring or for age

STUDY LIMITATIONS: Small *n* for a comprehensive meta-analysis • Differences in outcome measures across studies • Concurrent use of other treatments not controlled

LEVEL OF EVIDENCE: Later stage study of effect size across multiple studies

REFERENCE: Hine and Wolery (2006)

PARTICIPANTS (*n*): 2- to 3-year-old females, verbal (2)

STUDY DESIGN: Multiple baseline, intermittent probe, single subject

INDEPENDENT VARIABLES: Point-of-view video modeling for two play tasks

DEPENDENT VARIABLES: Number of different modeled actions performed per probe • Generalization to untrained materials and setting • Social validity ratings by naïve observers of appropriate play behavior

RESULTS: Increased use of modeled actions for both play tasks by both girls • Some evidence of generalization to untrained materials and setting • Some evidence of short-term maintenance • Higher appropriate play behaviors following treatment

STUDY LIMITATIONS: Small *n* • One child required additional prompting and reinforcement during skill acquisition • No long-term follow-up

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Bellini, Akullian, and Hopf (2007)

PARTICIPANTS (*n*): 4- to 5-year-old males, limited verbal, echolalia

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Video self-modeling of social interaction with same-age peer, with no additional prompting or reinforcement by adult during probes

DEPENDENT VARIABLES: Unprompted social engagement with same-age peer • Maintenance at short-term follow-up

RESULTS: Rapid and substantial increases in social engagement during treatment • Maintenance of increased social engagement at follow-up

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Appendix (continued)

STUDY LIMITATIONS: Small *n* • Short follow-up period • Raters not blind to treatment status • Variability of dependent variables

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Kroeger, Schultz, and Newsom (2007)

PARTICIPANTS (*n*): 4–6 years (25)

STUDY DESIGN: Matched, randomized group comparison (two groups)

INDEPENDENT VARIABLES: Group assignment: • VM direct teaching • Play activities group

DEPENDENT VARIABLES: Social behaviors (i.e., initiations, responses, interactions) • Small group learning skills

RESULTS: Significant improvement in social behaviors for both groups • Significantly greater improvement in social behaviors for VM group • Significant improvement for both groups on small group learning skills

STUDY LIMITATIONS: No follow-up • No generalization measures

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

Social Skills Intervention

REFERENCE: Bellini, Peters, Benner, and Hopf (2007)

PARTICIPANTS (*n*): School-age (157)

STUDY DESIGN: Meta-analysis of 55 multiple baseline/reversal single-subject studies, 1986–2005

INDEPENDENT VARIABLES: Type of school-based social skills intervention • Setting of intervention (classroom versus pullout) • Age group (i.e., preschool, elementary, secondary)

DEPENDENT VARIABLES: Treatment effect • Maintenance effect • Generalization effect

RESULTS: Low to questionable treatment and generalization effects • Moderate maintenance effects • No significant difference by type of intervention or age group • Classroom-based interventions significantly more effective than pullout

STUDY LIMITATIONS: Could not examine interaction effects of participant and treatment characteristics due to sample size • Study combines many different types of treatment methods • Only 15 studies examined generalization • Does not cite studies included in analysis

LEVEL OF EVIDENCE: Later stage study of effect size across multiple studies

SOCIAL SKILLS TRAINING

REFERENCE: Charlop-Christy and Kelso (2003)

PARTICIPANTS (*n*): 8- to 11-year-old males, verbal, literate

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Cue card / written script program

DEPENDENT VARIABLES: Appropriate conversational speech • Generalization to different setting, person, topic

RESULTS: All children met testing criteria for appropriate conversational speech with cue cards and after cue cards were removed • Generalization to untrained topic, person, and setting for all three

STUDY LIMITATIONS: Small *n* • No follow-up • Parents as generalization partners (not peers)

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Webb, Miller, Pierce, Strawser, and Jones (2004)

PARTICIPANTS (*n*): Mild 12- to 17-year-old males (10)

STUDY DESIGN: Quasi-experimental pre- and postgroup comparison

INDEPENDENT VARIABLES: SCORE Skills Strategy program

DEPENDENT VARIABLES: Social skill performance (i.e., share ideas, compliment, offer help, recommend changes, exercise self-control) • Skill knowledge • Situation discrimination • Opinion about group work • Parent ratings of teen's social skills

RESULTS: Significant increase in all skills (except share ideas) for the group • Significant increase in skill knowledge • Significant increase in situation discrimination • No change in opinion about group work • No significant change in parent ratings of social skills

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Appendix (continued)

STUDY LIMITATIONS: Small *n* • No control group • Outcome measures directly tied to treatment • Did not measure follow-up or generalization to other settings or people

LEVEL OF EVIDENCE: Exploratory, earliest stage

REFERENCE: Lopata, Thomeer, Volker, and Nida (2006)

PARTICIPANTS (*n*): Asperger syndrome; 6- to 13-year-old males (21)

STUDY DESIGN: Quasi-experimental pre- and postgroup comparison

INDEPENDENT VARIABLES: Cognitive-behavioral treatment (i.e., skillstreaming with behavioral component)

DEPENDENT VARIABLES: Parent and staff ratings of • Social skills • Adaptability • Atypical behaviors

RESULTS: Significant increase in parent and staff ratings of social skills • Significant increase in parent ratings of adaptability • Significant decrease in parent ratings of atypicality • Significant increase in staff ratings of atypicality

STUDY LIMITATIONS: Small *n* • No control group • Raters aware of treatment status • No follow-up or generalization

LEVEL OF EVIDENCE: Exploratory, earliest stage

SOCIAL STORIES

REFERENCE: Sansosti and Powell-Smith (2006)

PARTICIPANTS (*n*): Asperger syndrome 9- to 11-year-old males (3)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Individualized social story targeting: • Sportsmanship • Maintaining conversation • Joining in

DEPENDENT VARIABLES: Social engagement (specific target behavior)

RESULTS: Improved social engagement for two of the three boys approaching a level of social engagement equivalent to peers • No evidence of maintenance at 2-week follow-up

STUDY LIMITATIONS: Small *n* • Limited findings • Lack of consistency in treatment implementation • Coders not blind to treatment status

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Scattone, Tingstrom, and Wylczynski (2006)

PARTICIPANTS (*n*): 8- to 13-year-old males (3)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Social story regarding appropriate social initiations and responses

DEPENDENT VARIABLES: Appropriate social interaction toward peers

RESULTS: Increase in appropriate social interactions for two of three boys • Highly effective for one of three boys

STUDY LIMITATIONS: Small *n* • Limited findings • No follow-up • Coders not blind to treatment status • Concurrent treatment as a possible confounding variable

LEVEL OF EVIDENCE: Exploratory, earlier stage

PEER/SIBLING TRAINING

REFERENCE: Kamps et al. (2002)

PARTICIPANTS (*n*): Study 1: 9–10 years (5)

STUDY DESIGN: Single-subject ABAB reversal design

INDEPENDENT VARIABLES: Type of treatment: • Cooperative learning (two participants) • Social skills (two participants) • No treatment (one participant)

DEPENDENT VARIABLES: Social interaction: • Frequency • Mean length • Duration

RESULTS: Children in both treatment groups increased frequency and duration of social interactions during treatment • Children in cooperative learning group increased mean length of interactions during treatment

STUDY LIMITATIONS: Small *n* • No follow-up • No generalization

LEVEL OF EVIDENCE: Exploratory, earlier stage

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Appendix (continued)

REFERENCE: Kamps et al. (2002)

PARTICIPANTS (*n*): Study 2: 7–14 years (34)

STUDY DESIGN: Quasi-experimental pre- and postgroup comparison

INDEPENDENT VARIABLES: Two-year peer mediation treatment • Type of peer: • Trained peer • Familiar peer • Stranger peer

DEPENDENT VARIABLES: Duration of social interaction • Reciprocal interactions • Toy play • On topic verbalizations

RESULTS: Duration of social interaction and reciprocal interaction increased with trained peers and familiar peers (generalization) • Slight increase in on topic verbalizations with trained peers • Significantly different effects by peer group

STUDY LIMITATIONS: No control group • Cannot exclude maturation effect • Variability of treatment methods among participants • Limited verbal skills of some participants

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Thiemann and Goldstein (2004)

PARTICIPANTS (*n*): 6- to 9-year-old males (5)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Peer training • Direct instruction with written text cueing treatment (WTT)

DEPENDENT VARIABLES: Overall social interactions • Initiating (i.e., comments, compliments, requests) • Topic maintenance • Social validation ratings by naïve raters

RESULTS: Peer training improved overall social interactions for two of five children • WTT improved quality of interactions and topic maintenance for all • Four of five children increased initiations following WTT • Improved social validity ratings after WTT • Evidence for short-term maintenance of specific skills

STUDY LIMITATIONS: Small *n* • Short follow-up period • Coders not blind to treatment status

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Tsao and Odom (2006)

PARTICIPANTS (*n*): 3- to 6-year-old males (4)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Train siblings to socially engage with brothers with autism spectrum disorders

DEPENDENT VARIABLES: Ratings of sibling–target child dyad for the following: • Joint attention • Social behavior • Social validity ratings by naïve rater

RESULTS: Modest improvement in social interactions of three of four dyads • Increased responses to siblings initiations • Clear increases in joint attention for three of four participants • No evidence of generalization to other setting • Significant positive changes based on social validity ratings

STUDY LIMITATIONS: Small *n* • Treatment occurred over short period • Treatment actually decreased interactions for one sibling dyad • Effects were modest

LEVEL OF EVIDENCE: Exploratory, earlier stage

Augmentative and Alternative Communication

PICTURE EXCHANGE COMMUNICATION SYSTEM

REFERENCE: Carr and Felce (2007)

PARTICIPANTS (*n*): Limited verbal; 3–7 years (41)

STUDY DESIGN: Controlled group comparison (2 groups)

INDEPENDENT VARIABLES: Treatment group: • 15 hr of PECS training • Control (no PECS)

DEPENDENT VARIABLES: Child-to-adult initiations (total, communicative, with adult response) • Responses to adult-to-child initiations • Adult-to-child initiations

RESULTS: Significant increase in child-to-adult initiations for PECS group • Significantly more child-to-adult initiations for PECS group versus controls • Significantly more child responses to adult for PECS group

STUDY LIMITATIONS: No randomization • Coders not blind to treatment status • No follow-up • Presence of researcher at post-treatment testing may have biased PECS outcomes

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

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Appendix (continued)

REFERENCE: Yoder and Stone (2006a)

PARTICIPANTS (*n*): Nonverbal; 1.5–5.0 years (36)

STUDY DESIGN: Randomized group comparison (two groups)

INDEPENDENT VARIABLES: Group assignment: • Responsive education and prelinguistic milieu teaching • PECS

DEPENDENT VARIABLES: Frequencies of the following: • Requesting • Initiating joint attention • Object exchange turns

RESULTS: PECS resulted in significantly greater requesting for children with limited pretreatment joint attention than responsive education and prelinguistic milieu teaching

STUDY LIMITATIONS: Coders and examiners not blind to group assignment • No follow-up

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

REFERENCE: Markel, Neef, and Ferreri (2006)

PARTICIPANTS (*n*): 4- to 5-year-old males (2)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Training for improvisation using PECS

DEPENDENT VARIABLES: Improvised request using PECS

RESULTS: Boys successfully trained to request with novel combinations of PECS cards • Generalization to within-class untrained stimuli and natural settings

STUDY LIMITATIONS: Small *n* • Coders not blind to treatment status • Some incomplete probe data

LEVEL OF EVIDENCE: Later stage study of effectiveness for procedural variation

REFERENCE: Nunes and Hanline (2007)

PARTICIPANTS (*n*): Limited verbal, 4 year-old male (1)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: Parent-based naturalistic augmentative and alternative communication intervention using Picture Communication Symbol cards

DEPENDENT VARIABLES: Frequency of initiations and responses • Imitative responses • Modes of expression used

RESULTS: Increased use of initiations and responses during treatment • Modest generalization using gestures

STUDY LIMITATIONS: Small *n* • No generalization data to other people, settings • No follow-up • Coders not blind

LEVEL OF EVIDENCE: Later stage study of effectiveness for procedural variation

REFERENCE: Charlop-Christy, Carpenter, Le, LeBlanc, and Kelley (2002)

PARTICIPANTS (*n*): Limited to nonverbal, 3- to 12-year-old males (3)

STUDY DESIGN: Multiple baseline, single subject

INDEPENDENT VARIABLES: PECS training in multiple settings

DEPENDENT VARIABLES: Number of trials to reach phase criterion • Spontaneous and imitative responses • Social-communicative behaviors • Problem behavior

RESULTS: All three met PECS criterion • Increases in verbal speech for all three • Increases in social-communicative behavior • Decreases in problem behavior • Evidence of maintenance at 1-year follow-up

STUDY LIMITATIONS: Small *n* • Coders not blind • No generalization data

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Ganz and Simpson (2004)

PARTICIPANTS (*n*): Limited to nonverbal 3–7 years (3)

STUDY DESIGN: Single-subject design

INDEPENDENT VARIABLES: PECS training • Modeling of verbalizations

DEPENDENT VARIABLES: Proficiency of PECS use relative to phase criterion • Number of intelligible words spoken • Presence of nonword vocalizations

(continued)

Appendix (continued)

RESULTS: Rapid mastery of PECS Phases 1–4 by all three • Increase in verbal output for all three • Longer, more complex speech for all three
• No clear relationship between changes in spoken words and nonword vocalizations

STUDY LIMITATIONS: Small *n* • No baseline data • Coders not blind • No generalization • No follow-up

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Yoder and Stone (2006b)

PARTICIPANTS (*n*): Nonverbal; 1.5–5.0 years (36)

STUDY DESIGN: Randomized group comparison (2 groups)

INDEPENDENT VARIABLES: Group assignment: • Responsive education and prelinguistic milieu teaching • PECS

DEPENDENT VARIABLES: Non-imitative communication acts • Number of different non-imitative words spoken • Object exploration

RESULTS: PECS group showed significantly greater increase in non-imitative spoken acts • PECS group showed a significantly greater number of different non-imitative spoken words, especially for participants with high initial object exploration

STUDY LIMITATIONS: Coders and examiners not blind to group assignment

LEVEL OF EVIDENCE: Clinical trial of treatment efficacy

SIGN LANGUAGE TRAINING

REFERENCE: Tincani (2004)

PARTICIPANTS (*n*): Limited verbal 5–6 years (2)

STUDY DESIGN: Alternating treatment, single subject

INDEPENDENT VARIABLES: Treatment: • PECS • Sign language training

DEPENDENT VARIABLES: Motor imitations • Mands • Word vocalizations

RESULTS: Sign language training produced more speech for both than PECS • Mixed findings for mands • Evidence of generalization of PECS and sign to untrained people

STUDY LIMITATIONS: Small *n* • Disruptions during treatment due to setting • Limited communication opportunities during training • No follow-up • Coders not blind to treatment status

LEVEL OF EVIDENCE: Exploratory, earlier stage

REFERENCE: Carbone et al. (2006)

PARTICIPANTS (*n*): Limited verbal, 7-year-old female (1)

STUDY DESIGN: Alternating treatment, single subject

INDEPENDENT VARIABLES: Treatment: • Total communication (sign + vocal) • Vocal alone

DEPENDENT VARIABLES: Acquisition of picture tacts (labels)

RESULTS: Child acquired picture labels twice as quickly in total communication condition versus vocal alone • Child acquired four times the number of labels under total communication condition versus vocal alone

STUDY LIMITATIONS: Small *n* • No follow-up

LEVEL OF EVIDENCE: Exploratory, earlier stage

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