
Evidence-Based Review of Interventions for Autism Used in or of Relevance to Occupational Therapy

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KEY WORDS

- autism spectrum disorder
- pediatrics
- systematic review

Occupational therapy practitioners are among the professionals who provide services to children and adults with autism spectrum disorder (ASD), embracing both leadership and supportive roles in service delivery. The study's primary aims were as follows: (1) to identify, evaluate, and synthesize the research literature on interventions for ASD of relevance to occupational therapy and (2) to interpret and apply the research literature to occupational therapy. A total of 49 articles met the authors' criteria and were included in the review. Six categories of research topics were identified, the first 3 of which are most closely related to occupational therapy: (1) sensory integration and sensory-based interventions; (2) relationship-based, interactive interventions; (3) developmental skill-based programs; (4) social cognitive skill training; (5) parent-directed or parent-mediated approaches; and (6) intensive behavioral intervention. Under each category, themes supported by research evidence and applicable to occupational therapy were defined. The findings have implications for intervention methods, communication regarding efficacious practices to professionals and consumers, and future occupational therapy research.

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As autism has become a prevalent problem observed in society, interventions and programs to improve the quality of life of people with autism have proliferated. The number of children diagnosed with autism spectrum disorder (ASD) has increased in the past 10 years, and prevalence is currently estimated to be 1 in 150 (Centers for Disease Control and Prevention [CDC], 2007). With this increase comes a high need for services and programs that effectively promote the performance and participation of people with ASD as students, family members, and workers. Occupational therapy practitioners are among the professionals who design and provide intervention services to people with ASD and their families. To provide the most effective services and programs for children and adolescents with ASD, it is important that occupational therapists become informed about the interventions with best evidence of effectiveness. This systematic review provides a synthesis of current research on interventions and an interpretation of findings for clinical application.

Children with ASD have a range of occupational and performance problems that interfere with their full participation in school, home, and community activities. Predominant characteristics of autism that are often the focus of intervention include limited social interaction (Gevers, Clifford, Mager, & Boer, 2006), delayed or deficit language (Smith, Goddard, & Fluck, 2004), behavioral problems (Horner, Carr, Strain, Todd, & Reed, 2002), and sensory-processing difficulties (Baranek, 2002; Dawson & Watling, 2000). Early in life, children with ASD may lack imitation and may exhibit stereotypic behaviors. At young ages, they do not gesture to communicate or relate to others with eye contact and verbalizations. By 3 to 5 years,

children with ASD may not have developed language or may have limited speech; many use words but not with communicative intent. Important aspects of social emotional functioning, such as reading facial expressions, understanding gestures and nonverbal communication, recognizing inflection, and using language, are delayed or deficit (Dawson & Galpert, 1990). The social play of children with ASD is substantially limited, lacking joint attention, creativity, and pretend scenarios. Greenspan and Wieder (1997) described absent joyful interactions and engagement that reflects interest in and attachment to others.

Most children with ASD have sensory-processing disorders. Although visual-spatial skills may be more advanced, other sensory responses, such as those to touch and auditory input, suggest poor modulation. Greenspan and Wieder (1997) estimated that 39% of children with ASD are under-reactive to sensation, 20% are hypersensitive, and 36% show a mixed pattern of hypersensitivity and hyposensitivity. These children often have aversions to olfactory and gustatory sensations and, as a result, may be highly restrictive in what they eat. Baranek (2002) also documented that many children with ASD demonstrate unusual sensory responses (e.g., hyporesponses and hyperresponses) to touch and auditory stimulations. These underlying impairments create barriers to their ability to develop social relationships, function in everyday environments (such as the classroom or playground), and learn social rules.

Given this breadth and depth of performance limitations, children and adolescents with ASD need a range of interventions and educational programming. In young children with ASD, occupational therapists often focus on enhancing children's sensory processing, sensorimotor performance, social-behavioral performance, self-care, and participation in play. In older children and adolescents, occupational therapy goals may focus on social and behavioral performance, transition to work, and independence in the community. In most settings, occupational therapists are members of an interdisciplinary team of professionals who evaluate, plan, and implement the child's program. This systematic review of the research literature considers the range of problems exhibited by people with ASD and the range of intervention approaches that can be or are used by occupational therapy practitioners. It considers both the direct service roles and supportive team roles that occupational therapy practitioners demonstrate.

Methods

This study was initiated and supported by the AOTA as part of the Evidence-Based Literature Review project. The goal of the project is to promote evidence-based practice through

a variety of dissemination efforts, including publication of the results of systematic reviews in peer-reviewed journals. A focused review question was developed by the authors and reviewed by an advisory group of experts in ASD. According to the consensus of the group, for the purposes of the review, the definition of ASD included autism, Asperger's disorder, and pervasive developmental disorder. Search strategies were to include occupation and engagement in addition to performance-based interventions. The role of family, family coping, behavior, self-regulation, and the contextual components of intervention were also to be included in the search. In addition, there was consensus that multicomponent, multidisciplinary programs as well as focused programs that are adjunctive to broader behavioral interventions should be included in the review.

The authors, in conjunction with a medical librarian with experience in evidence-based reviews, selected research reports of relevance to occupational therapy, analyzed and summarized the reports, and interpreted the information for occupational therapy practice.

Research Question

The following research question guided selection of research studies for the review and interpretation of the findings:

- What is the evidence for the effect of interventions used in or of relevance to occupational therapy in children and adolescents with autism spectrum disorder?

Procedures

A broad search was undertaken to identify research reports for the review. Databases and sites searched included Medline, CINAHL, ERIC, PsycINFO, Social Sciences Abstracts, Sociological Abstracts, Linguistics and Language Behavior Abstracts, RehabData, Latin American and Caribbean Health Sciences Literature, and EBSCOHost. In addition, consolidated information sources, such as the *Cochrane Database of Systematic Reviews* and the *Campbell Collaboration*, were included in the search. These databases are peer-reviewed summaries of journal articles and provide a system for clinicians and scientists to conduct evidence-based reviews of selected clinical questions and topics.

Search terms were developed by the authors and reviewed by the advisory group (Table 1). Articles were included in the review if they provided evidence for an intervention approach used with children or adolescents with ASD, had been peer reviewed, were published between 1986 and 2007, and addressed a performance area or intervention approach within the domain of occupational therapy. Only studies determined to be *Level I* (i.e., randomized controlled trials, systematic reviews, and meta-analyses), *Level II* (i.e., nonrandomized clinical trials such as cohort

Table 1. Search Terms Used to Identify Research Reports

Category	Key Search Terms
Sample/client population	autism (excluding Rett's syndrome and childhood disintegrative disorder), autism spectrum disorder, Asperger syndrome, pervasive developmental disorder
Intervention	occupational therapy, sensory integration, touch pressure, massage, therapeutic listening, auditory integration training, play, activities of daily living, social participation, assistive technology, augmentative communication, neuromotor, peer mediated, social stories, perceptual motor learning, behavior intervention, applied behavioral analysis, discrete trial training, comprehensive, developmental, Treatment and Education of Autistic and Communication Handicapped Children (TEACCH), relationship-based interventions, friendship, job training, peer group, peer interaction, self-care, instrumental activities of daily living, antisocial behavior, adaptive behavior, cooperative behaviors, social skills training, family coping, coping skills, social competence, problem solving, decision-making skills, token economy, activity groups
Outcomes	self-care, education, transition to work and community, play, leisure, social participation, communication, affect, behavior

studies), and *Level III* evidence (i.e., before–after, one group designs) were included. Research reports were excluded if they were published before 1986, were *Level IV* or *V* evidence (descriptive studies that include analysis of outcomes, such as case series and single-subject design, and case reports and expert opinion, such as narrative literature reviews and consensus statements), used qualitative methods to the exclusion of quantitative methods, were not peer reviewed, or had serious design limitations. Of the 17,440 citations reviewed, 217 articles appeared to have relevance to occupational therapy and were selected to determine whether they fit the criteria. The first author, the AOTA consultant, and AOTA staff made the final selection of the studies using the established criteria.

The first author analyzed the studies ($n = 49$) by describing and evaluating the study level, study design, number of participants, types of interventions and outcome measures, summary of results, study limitations, and implications of the study for occupational therapy. Guidelines for reviewing quantitative studies were based on those developed by Law (2002) to ensure that the evidence was ranked according to uniform definitions of research design elements. An evidence table that included interpretation of findings for occupational therapists was created and reviewed by both authors. Among the 49 studies, 18 were Level I, 17 were Level II, and 14 were Level III evidence. This systematic review presents a synthesis of the findings.

Results

The results were organized by the autism intervention approaches represented in the literature. The studies were categorized into the following topics: (1) sensory integration and sensory-based interventions, (2) relationship-based, interactive interventions, (3) developmental skill-based programs, (4) social–cognitive skill training, (5) parent-directed or parent-mediated approaches, and (6) intensive behavioral intervention. These categories were ordered by those inter-

ventions most likely to be directly used by occupational therapists to those of relevance to their supportive team roles. Across the studies, certain themes consistently emerged, suggesting their importance to clinical practice; the themes are presented in *italic* type.

Sensory Integration and Sensory-Based Interventions

Occupational therapists frequently focus on sensory-processing problems in children with ASD. Although occupational therapists clearly have expertise in sensory integration and sensory-based interventions (Bundy, Lane, & Murray, 2002), occupational therapy studies of the effects of sensory integration approaches with children with autism are few (see Baranek, 2002, for a review). Interventions focused on sensory processing can be categorized as sensory integration, sensory-based interventions (e.g., massage, brushing), and auditory integration training (which is similar to therapeutic listening used by occupational therapists). Of the 8 studies identified, all were Level I; 5 examined auditory integration training, 2 investigated the effects of massage, and 1 was a systematic review of sensorimotor interventions.

Sensory integration intervention appears to enhance the child's ability to modulate behavior and participate in social interaction; however, findings are inconclusive at this time (Baranek, 2002). One goal of sensory integration intervention is to improve the child's ability to modulate arousal, resulting in well-organized, adaptive responses. In her systematic review of sensory and motor intervention for children with autism, Baranek (2002) identified Level III and IV studies of sensory integration intervention with children with autism (Ayres & Tickle, 1980; Case-Smith & Bryan, 1999; Linderman & Stewart, 1999). In these studies of young children with ASD, sensory integration intervention was associated with positive changes in social interaction, purposeful play, and decreased sensitivity. Limitations of the studies included small sample size and lack of control groups. Although each of these studies had positive findings, when combined, the evidence remains weak and requires further study.

Sensory-based interventions, such as those that provide therapeutic touch, can decrease maladaptive behaviors, reduce hyperactivity, inhibit self-stimulation and stereotypic movements, and improve attention and focus (Escalona, Field, Singer-Strunck, Cullen, & Hartshorn, 2001; Field et al., 1997). One sensory technique, massage, when implemented daily, can improve attention and reduce stereotypic behaviors. Two randomized controlled trials (Level I evidence) investigated the effects of massage on children with ASD (Escalona et al., 2001; Field et al., 1997). Field et al. (1997) compared a group of boys with autism who received massage for 4 weeks (2 days per week) to boys with autism who played a game for the same amount of time. The boys who received massage exhibited decreased aversion to touch, off-task behavior, and stereotypic behavior. Limitations of the study included lack of standardized measures and short-term intervention. In a similar study, Escalona et al. (2001) compared children with ASD who received massage administered by their parents every night for a month to a comparison group whose parents read to them every night. The children who received massage demonstrated reduced hyperactivity, decreased impulsivity and stereotypical behaviors, and improved on-task behaviors. The researchers attributed the positive findings to improved sleep after massage.

Therapy approaches that use the auditory system (i.e., therapeutic listening and auditory integration training) to promote integration and organization of the central nervous system have inconclusive evidence for their effectiveness (Sinha, Silove, Wheeler, & Williams, 2004). Five Level I studies of auditory integration training (AIT) have examined the effects on people with ASD (Bettison, 1996; Edelson et al., 1999; Mudford et al., 2000; Sinha et al., 2004; Zollweg, Palm, & Vance, 1997). AIT provides the basis for therapeutic listening programs (e.g., Frick & Hacker, 2001) that are used in occupational therapy. In AIT, children listen to modulated music through headphones several times a day for 10 or more consecutive days. In all of the AIT studies, the children's behavior improved (i.e., aberrant behaviors decrease); however, listening to modulated music was no more effective than unmodulated music. Results of these studies indicate that listening to music through headphones can improve problem behavior. Positive results specific to AIT were demonstrated in one long-term randomized clinical trial by Edelson et al. (1999). These investigators found that participants who received the AIT improved more in aberrant behaviors, sound sensitivity, and eye contact (by report of their parents). In a recent Cochrane systematic review of AIT, Sinha et al. (2004) synthesized the research literature of AIT for people with ASD. They found that the evidence for AIT effectiveness was weak and inconclusive. Given inconclusive evidence, occupational therapy practitioners

should closely monitor the child's behaviors when using therapeutic listening or AIT to determine individual effects on the child.

Most scholars recommend use of sensory-based interventions as one component of a comprehensive intervention that uses a variety of methods to promote performance (Baranek, 2002; Greenspan & Wieder, 1997). Although some positive benefits from sensory-based treatment have been documented, it is not clear how these interventions promote the child's overall functional and educational outcomes (Baranek, 2002). Sensory-based interventions, including modifying the sensory environment, appear to be most effective when children exhibit sensory-processing deficits with problems in arousal, attention, or behavior. Scholars recommend that occupational therapists pair sensory-based interventions with functional tasks in which the child practices the targeted performance outcome (Baranek, 2002; Mailloux & Roley, 2004; Parham & Mailloux, 2005). Additional study is needed to determine whether effects are sustained and generalized to different skill sets. Future research studies should include measurement of both physiological and performance effects to determine the mechanisms through which sensory-based interventions influence behavioral and performance outcomes.

Relationship-Based, Interactive Interventions

Occupational therapy practitioners often combine sensory integration intervention with interactive play activities individually designed to enhance the child's play and social participation. These interactional or relationship-based interventions focus on improving social-emotional growth in children with ASD and match the philosophy of occupational therapists. Eleven research reports (2 Level I, 2 Level II, and 7 Level III) investigated the effects of relationship-based interventions. These studies included parents, peers, and therapists in interactive play-based activities and examined social competence and social engagement outcomes. Effects of these interventions were positive, but small.

Relationship-based interventions (e.g., Hwang & Hughes, 2000) that use adult imitation of the child's actions, implement high levels of positive responsiveness, apply prompting and cueing, facilitate peer interactions, establish environments that support social interaction, and demonstrate positive effects on social engagement in children with ASD. Hwang and Hughes (2000) completed a comparative review to examine the effects of naturalistic social interactive interventions on increasing children's social communicative skills, particularly their initiation of social interactions. The focus of this review was research on naturalistic interventions such as contingent imitation, naturally occurring reinforcement, and arrangement of the environment to increase the child's interest in

activities. The outcomes examined were social behavior such as requesting assistance, greetings, eye gaze, joint attention, and imitation. This analysis of 16 studies identified specific strategies, many of which can be used by occupational therapy practitioners, that demonstrate evidence of effectiveness. Several of the studies in the review reported generalization of skills and maintenance of positive findings. One finding was that waiting for a child to respond (i.e., pausing before cueing again) increased children's verbal responses and participation in conversation. Arranging the environment to present challenges to the child (e.g., placing favorite toy on high shelf) increased communication attempts. Imitating the child drew in his eye gaze and resulted in positive affect and attending. Hwang and Hughes (2000) identified adult imitation of the child's actions as an effective strategy to promote the child's participation in interactive play.

In a randomized clinical trial (Field, Field, Sanders, & Nadel, 2001) of 20 children with autism, the children whose actions were imitated were more focused in their play and demonstrated more interactive behaviors. A Level III study (Dawson & Galpert, 1990) also examined the effects of mother's imitation of her child's play. Although the children's gaze to mother and the number of play schemes increased, vocalization and positive affect did not change. Both studies of adult imitation of the child were short term (three sessions or 2 weeks), and only short-term effects were measured.

Structured play activities, such as block construction or games that include cueing, prompting, and reinforcement, are effective interventions to enhance turn-taking, sharing, communication, and social interaction in children with ASD (Legoff, 2004). Several studies examined the effects of social games and play activities with peers on children's development of social interaction skills, communication, and play development (Legoff, 2004; Legoff & Sherman, 2006; Schleien, Mustonen, & Rynders, 1995). Legoff completed 2 studies (Level II) that examined the effects of Lego therapy on social competence in children with ASD. The intervention studied was similar to occupational therapy activity groups in that children played with Legos and followed simple social rules, the focus was cooperative play and fun, peers and aides facilitated the play, members participated in joint decisions, and family support was included. Legos were selected because children with autism often have an affinity for constructing with blocks and appear to prefer structured activities to creative or pretend play. Building a large structure automatically requires cooperation and social interaction. By establishing social rules, encouraging interaction and sharing, and facilitating problem solving, children made gains in social interaction and social competence. The intervention had positive effects, including a 175% increase in

the duration of social interaction with peers during free play (Legoff, 2004).

In the follow-up study (Legoff & Sherman, 2006), in which a matched sample of children was compared with the group who participated in Lego therapy for a 3-year period, the Lego therapy group exhibited higher social interaction. These studies suggest that consistency and sameness in activities may allow children with autism to focus on social interaction and cooperation. Importantly, the elements of the play groups, that is, rules for cooperation, selection of materials of high interest, facilitation of sharing and turn-taking, support of families and peers, appeared to be critical to the positive results.

Two other Level III studies of activity-based intervention, art activities (Schleien, Mustonen, & Rynders, 1995) and play sessions in a gym (Schleinen, Mustonen, Rynders, & Fox, 1990), were similar to occupational therapy in that they used a specific activity to encourage cooperation and positive interaction in children with ASD. These studies demonstrated the importance of typical peer models in promoting social interactions in children with ASD.

Intervention emphasizing responsive, supportive relationships, and social-emotional development in young children can facilitate the child's social-emotional growth and promote development of pivotal behaviors essential for learning (Greenspan & Wieder, 1997; Mahoney & Perales, 2005; Wieder & Greenspan, 2005). In these Level III studies, parental responsiveness and sensitivity to the child's communication attempts created a foundation for the child's developmental growth. Greenspan and Wieder (1997) completed a chart review of 200 children who had participated in relationship-based floor-time therapy with their parents and comprehensive interdisciplinary interventions. After 2 to 3 years of intervention, they found that 58% of the child outcomes were good to outstanding, 25% were medium, and 17% were limited. Wieder and Greenspan (2005) reported a follow-up of 16 of the children whose initial outcomes had been good to outstanding. These children were evaluated 10 to 15 years after they had participated in a 2 or more year period of relationship-based (floor time) intervention. The children with optimal outcomes had become socially competent, responsive, and interactive; they exhibited some mental illness (depression and anxiety), but the primary characteristics of autism were no longer evident.

Mahoney and Perales (2005) completed a one-group pre- and postassessment study measuring the effects of relationship-focused intervention on young children with pervasive developmental disorders that encouraged parents (primarily mothers) to increase their responsive to their children. As in the Greenspan and Wieder studies (Greenspan & Wieder, 1997; Wieder & Greenspan, 2005), a primary focus of the

intervention was to guide parents to develop positive interactional skills, that is, responsiveness and sensitivity to their child. After a year of the relationship-focused intervention, mothers made significant increases in responsiveness and children made significant gains in socioemotional functioning (Mahoney & Perales, 2005). These studies suggest that occupational therapists embrace parents within their intervention and coach them in methods that promote their child's socioemotional growth. Coaching models and interventions that focus on playful turn-taking have been described in the occupational therapy literature for many years (Hanft, Rush, & Shelden, 2004; Knox, 2005). Studies by Greenspan and Wieder (1997; Wieder & Greenspan, 2005) suggested that relationship-focused intervention are effective when working with young children who appear relatively high on the spectrum and parents who appear to have the resources and energy to become intensely involved in the intervention activities.

Developmental Skill-Based Programs

Comprehensive programs for young children with autism typically use developmental-based instructional models that include occupational therapy services. These programs are play based, use peers, focus on strengths of the child, and involve professionals from multiple disciplines (Audet, Mann, & Miller-Kuhaneck, 2004). Two prominent programs that use a developmental and comprehensive approach are the Denver Model, developed by Sally Rogers (Rogers & DiLalla, 1991), and Treatment and Education of Autistic and Communication Handicapped Children (TEACCH), originally developed by Schopler and Reichler (1971). Six studies (4 Level II, and 2 Level III) examined these programs or similar programs.

Programs that emphasize a developmental, play-based approach that emphasizes positive affect, nonverbal communication play, social relationships, and classroom structure have small positive effects (Rogers, Herbison, Lewis, Pantone, & Rels, 1986). In a Level III descriptive study using one group of young children with ASD, Rogers et al. (1986) measured play and development skill before and after a 6-month preschool program. The 26 children who participated demonstrated positive changes in cognition, communication, and social emotional skills beyond their developmental trajectory. Although the results were significant, lack of a comparison group or control condition is a serious limitation. In a second Level III study, Rogers and DiLalla (1991) completed a retrospective analysis of children's change in developmental rate before and after 8 to 12 months of intervention. During this intervention period, the children improved more than was expected in all developmental areas (in a 10-month period, the children with ASD made almost a 10-month developmental gain in language). This comprehensive program appears beneficial; however, more rigorous trials are needed.

Children with ASD often have strengths in visual perception (particularly of inanimate objects). Interventions that use visual cueing and visual learning are effective in promoting communication and learning (Ozonoff & Cathcart, 1998; Panerai, Ferrante, & Zingale, 2002). One such program, TEACCH, was developed in the 1960s and has been widely disseminated (Schopler, Mesibov, & Baker, 1982). As noted by Watling (2004), strategies from TEACCH, such as use of visual schedules, fit easily in the intervention strategies of the occupational therapist. The program can be implemented by parents with support from professionals or may be implemented primarily in the classroom. The focus is a structured teaching environment that visually cues the child with an emphasis on alternative communication systems, generally using pictures or photographs and visual cueing (Watling, 2004). Ozonoff and Cathcart (1998) examined the effects of a TEACCH-based home program in a Level II nonrandomized trial. After a 10-week program, the children in the TEACCH intervention improved more than the control group on imitation, fine and gross motor skills, and cognitive performance.

In another Level III study from Italy, Panerai et al. (2002) compared the effect of the TEACCH program to an inclusive education program. In this year-long study of 16 children, 8 received the TEACCH program, and 8 were in an integrated classroom. The program was individualized to each child and emphasized environment adaptation and alternative communication in the classroom. The control group was integrated into regular classrooms with support teachers and outpatient motor and speech therapy. The children in the TEACCH program improved significantly in imitation, perception, gross motor skills, eye-hand coordination, cognitive performance, and developmental ages. They also improved in adaptive behaviors.

TEACCH programs establish a visual environment that cues the child as to what activity comes next and guides the child's in sequencing and completing an activity (Ozonoff & Cathcart, 1998). These programs are effective in improving motor and cognitive performance. Occupational therapists use visual schedules, picture exchange communication systems, computer games, and visual cueing to promote the child's participation in the classroom and in other school occupations such as eating, toileting, and playground activities (Shepherd, 2005). These Level II studies provide evidence for the effectiveness of visual strategies.

Developmental skill-based approaches are typical of those found in many preschools; for ASD, developmental approaches tend to be highly structured with emphasis on social interaction and pretend play skills. Several of the approaches emphasize visual cueing and environmental modification. The evidence for effectiveness is weak, because only

Level II or III studies support these interventions; however, all of the studies found positive effects across multiple developmental domains.

Social-Cognitive Skill Training

A pervasive characteristic of autism is difficulty with or lack of social skills. Children with ASD may exhibit aberrant behaviors that interfere with social interaction. Most exhibit lack of eye contact, and few demonstrate conversational skills. Programs to teach social skills are designed to help children with ASD learn and practice the steps involved in social interaction, for example, turn-taking, joint attention, eye contact, nonverbal communication, and language (Greene, 2004). Eight reports examined social-cognitive interventions; 1 Level I, 3 Level II, and 4 Level III.

Cognitive-based social skills training in which simple, discrete steps of social-emotional skills are explained, modeled, and practiced appears to have modest, positive effects (Ozonoff & Miller, 1995). Most experts acknowledge that children with ASD lack the ability to infer the mental states of others (theory of mind; ToM). Three studies of cognitive-based social skills programs (Bauminger, 2002; Gevers et al., 2006; Ozonoff & Miller, 1995) investigated the effects of teaching children ToM. This training is most often used with groups of older children or adults with high functioning ASD. In Ozonoff and Miller (1995), the adolescents who participated performed marginally better on the ToM tasks and improved in social skills; however, they continued to have difficulty generalizing these skills to everyday conversations and interactions. In a more recent Level III study, Gevers et al. (2006) examined the effects of a ToM-based social cognitive training on children with pervasive developmental disorders. They found that the children improved significantly on the ToM test and in adaptive behaviors. Bauminger (2002) also studied the effects of an intervention focused on improving ToM and social cognition. In this Level III study, children were taught about emotions, social-interpersonal problem solving, and social skills. After the 7-month intervention, children improved in social problem solving, emotional understanding, and social interactions. The study resulted in global improvements; however, the research design was weak, and it was not clear that social competence with peers had improved. Based on the three studies identified in our search, evidence for the efficacy of ToM approaches is inconclusive, in particular, generalization of social skills appears limited.

Limited gains in social interaction of adolescents are made through social skills training in groups (Broderick, Caswell, Gregory, Marzolini, & Wilson, 2002; Howlin & Yates, 1999; Ozonoff & Miller, 1995). Howlin and Yates (1999) held group meetings each month for a year with a group of adolescents and young men. Within the sessions, total amount

of speech did not change, but the appropriateness improved. Participants of the group improved in maintaining and initiating conversation. In a second Level III study investigating the effects of social skill groups on adolescents with ASD (Broderick et al., 2002), participants reported more confidence after the group, and self-esteem improved. The results of both studies should be interpreted with caution because they used small, nonrandomized samples and did not have control groups.

Social Stories (Gray, 2000), which are often implemented by occupational therapists to guide and teach appropriate behavior to children with ASD, demonstrate small positive effects (Reynhout & Carter, 2006). These individualized stories are read to the child before an event to give him or her directives for expected behaviors. Social Stories present descriptive, directive, perspective, and affirmative statements to teach children positive or appropriate behaviors. They often include praise or reinforcement for positive behaviors. Social Stories complement occupational therapy because they apply an individualized approach to improving targeted behaviors, and they elicit the child's active participation. Reynhout and Carter (2006) reviewed the empirical evidence on the effects of Social Stories in a systematic review (Level I) that included 16 studies, 12 of which were single-subject design. Nine studies reported appropriate reduction in the targeted behavior, and 8 studies reported a desired increase in targeted behavior. Although positive behavioral changes resulted, the combined effects were minimal. It is not clear what age and type of child benefits most for this approach, and long-term effects have not been researched.

Parent-Directed and Parent-Mediated Approaches

Parent education is typically a component of occupational therapy intervention. Most parent education programs are designed to meet one of two goals: (1) to improve their child's performance or (2) to manage their child's behavior and decrease maladaptive behaviors. Researchers have examined the effects of training parents to provide intervention to their children with autism. Five studies (3 Level I, 2 Level II) focused on parent training and education. Some of the researchers were also interested in reducing parents' stress through education about autism. One concept underlying the efficacy of parent training is that parents are with their children for a large portion of the day and can create a consistent home environment for learning. In addition, parents often desire to be extensively involved in their children's interventions. When negative behaviors are present, parents often request help in managing problem behaviors with the goal of improving family functioning.

Parent education about autism and behavior management can improve the parent's confidence and self-esteem and can

improve the child's behavior (Sofronoff & Farbotko, 2002; Sofronoff, Leslie, & Brown, 2004). However, training parents to implement skill-based interventions has mixed evidence for its effectiveness in promoting the child's performance and does not lower parent stress (Diggle, McConachie, & Randle, 2003; Drew et al., 2002). Three studies focused on training parents to implement interventions. In a Level II study using non-randomized groups, Koegel, Bimbela, and Schriebman (1996) compared two paradigms for training parents: (1) teaching parents to motivate and respond to their children to improve their pivotal responses and (2) teaching parents to train their children in targeted behaviors. The parents who were taught to focus on motivating and responding to their children exhibited significantly more positive parent-child interaction than parents trained to teach and reward their children for performance. The pivotal behavior training also appeared to lower the parents' stress. Teaching parents how to train their children in targeted behaviors did not result in any differences in child behavior.

Diggle et al. (2003) completed a systematic review of parent mediated intervention with young children with ASD. In this Level I Cochrane review, the authors searched for studies in which parents were the mediators of intervention. Two studies were identified for inclusion. In one study, parent-mediated early intervention was compared with community day care and was found to have a significant positive effect on the child's language. In the second study, parent training was compared with intensive treatment, and the intensive treatment resulted in more significant improvement in IQ, nonverbal cognitive ability, and everyday living skills and behavior. Diggle et al. (2003) concluded that parent-mediated intervention is slightly more effective than community day care but is not as effective as intensive home-based treatment; however, because the review is based on two studies these conclusions should be viewed with caution.

Two studies by researchers from Australia focused on parents' management of the child's behavior with the goal of improving family function or reducing parent stress. Sofronoff and Farbotko (2002) evaluated the effectiveness of parent management training on self-efficacy in parents with children with Asperger's disorder using nonrandomized group comparison (Level II). Parents who attended a workshop or individual sessions on behavior management were compared with a control group. The parents in both the workshop and individual sessions improved in self-efficacy. The children's behavior changed immediately after intervention, but that change was not maintained at the 3-month follow-up. Sofronoff et al. (2004) replicated this study in a randomized trial with 51 parents. They compared improvement in child behavior and social skills in parents who

attended a workshop, a second group of parents who attended individual sessions, and a third parent group who served as control participants. The training resulted in reduction of the children's problem behaviors and improvement in their social skills. As in the first study, the format of the training did not produce significant differences, and the parents rated the information in both formats as useful. Parent training appears to be effective in reducing problem behaviors and enhancing social skills for children with Asperger's disorder.

Occupational therapy practitioners use family-centered approaches in which the family's priorities are valued and family members participate in the intervention. Parents desire information about their child and the diagnosis and ask for strategies to improve their child's performance or manage difficult behaviors (Humphry & Case-Smith, 2005). Studies show parent education is helpful in managing behaviors; however, children's performance may not improve when parents are trained to provide intervention (Koegel et al., 1996). Hinojosa (1990) reported that parents should not be asked to become their child's therapist or to implement prescribed interventions. Occupational therapists should demonstrate sensitivity to how parents would like to be involved in their child's therapy program. Evidence for parent-mediated therapy shows inconsistent effectiveness (Diggle et al., 2003), warranting caution about parent training approaches.

Intensive Behavioral Intervention

Behavioral interventions are widely used with children with ASD and have the strongest base of research evidence. Occupational therapists generally do not design or direct intensive behavioral intervention; however, they may consult with the behavioral therapists, collaborate with the behavioral team, recommend strategies that meet children's physiological or sensory needs during the program, or provide support and information to families who participate in behavioral programs. Ten studies (4 Level I, 5 Level II, 1 Level III) of intensive behavioral interventions were identified. The Level I studies included 2 randomized clinical trials and 2 systematic reviews. Of the 10 studies, 9 focused on Early Intensive Behavioral Intervention (EIBI) using applied behavioral analysis and discrete trial training.

EIBI using one-on-one discrete trial training is widely applied to children with ASD and has evidence of moderate to strong effects (Lovaas, 1987; Sallows & Graupner, 2005; Smith, Groen, & Wynn, 2000). The original study of discrete trial training, published in 1987, described a nonrandomized trial by Lovaas. This study compared 19 young children with autism who received 40 hr per week of intensive discrete trial

training to 19 children with autism who received 10 or fewer hours per week of similar training. Each group received at least 2 years of treatment and was posttested approximately 2 years after treatment ended. At the time of posttesting, 9 children who had received the intensive behavioral treatment had been placed in regular education classrooms and had IQs in the normal range. Of the children in the control group, only 1 was in regular education and had an IQ in the normal range. A follow-up study by McEachie, Smith, and Lovaas (1993) evaluated this same group of children. The intensive treatment children continued in the program for approximately 5 years and had maintained the original positive results, that is, 9 of 19 were in regular education and 11 demonstrated an IQ of at least 80. The control group had continued the less intensive treatment for an average of 3 years, and although none were in regular education, 3 demonstrated an IQ of at least 80. Therefore, McEachie et al. (1993) confirmed the original results of Lovaas.

Research since the original studies has confirmed the benefits of EIBI, although lower effects have been demonstrated in more recent studies. In 2000, Smith, Groen, and Wynn examined the effectiveness of discrete trial training with young children who had pervasive developmental disorders. Fifteen children (12 boys) received the intensive treatment for 30 hr per week over 18 months and were compared with a group of 13 children (11 boys) who received parent training 5 hr per week for 3 to 9 months. In a follow-up assessment 4 to 5 years after intervention began, the children who received the intensive behavior treatment achieved significantly higher IQs, visual-spatial skills, and language development. Adaptive behaviors were no different in the two groups.

Cohen, Amerine-Dickens, and Smith (2006) also replicated the findings from the Lovaas studies using EIBI. In this 3-year prospective Level II study, 21 children with ASD received EIBI, and 21 who were age and IQ matched received community-based services. The children in EIBI received intensive services, primarily in the home, for 1 year; then they received less-intensive services emphasizing peer interaction in preschools; finally they moved to integrated models of service delivery that involved primarily consultation, environmental modification, and facilitation of peer interaction. At the end of Year 3, the children in EIBI were significantly higher in IQ, language comprehension, and adaptive behavior. They were not higher on other cognition measures and expressive language. This study supported the positive effects of EIBI but did not find the dramatic effects reported in earlier studies (e.g., Lovaas, 1987).

Sallows and Graupner (2005) examined whether a community-based program in which parents were taught to implement discrete trial training (32 hr) could produce the same results as a therapist-directed, intensive (40 hr), clinic-

based treatment. Using a randomized controlled trial (Level I), a clinic-based, therapist-directed group of children with autism was compared with a parent-directed group. After 4 years of treatment, the children in both groups improved 25 points in IQ; cognitive, language, adaptive behavior, and social behavior outcomes for the two groups were similar. Both intensive interventions resulted in clinically significant changes, suggesting that parent-mediated intervention can be as effective as therapist-directed sessions. Children with initially higher imitation, language, and social responsiveness initially made the greatest gains.

Eldevik, Eikeseth, Jahr, and Smith (2006) investigated behavioral treatment using discrete trial training at a lower intensity than it was originally researched by Lovaas (1987). In a Level II study, this research team from Norway retrospectively compared children who had received low-intensity behavioral treatment (12.5 hr/week for 20 months) with children who received a comparable amount (12 hr/week for 20 months) of eclectic treatment (e.g., alternative communication and sensorimotor therapies). The children who received the behavioral treatment made significantly greater gains in intellectual functioning, language, and communication. The groups did not differ in daily living skills or adaptive behavior. These studies suggest that EIBI can produce positive effects when implemented in a more integrated way and on a less intensive schedule than originally proposed by Lovaas. Performance gains with behavioral treatments may not include adaptive behaviors such as self-care or activities of daily living.

Positive behavioral support has moderate to strong positive effects in reducing problem behaviors in children with ASD. A systematic approach that includes prevention of problem behaviors by applying consistent instruction and consequences to behavior, modifying the environment to promote appropriate behaviors, and collecting data to monitor children's progress appears to be highly effective (Horner et al., 2002). Horner et al. (2002) completed a research synthesis of interventions designed to improve problem behaviors (e.g., aberrant or maladaptive behaviors). They emphasized behavioral interventions typically implemented in the natural environment (e.g., a preschool where peers are present), primarily positive behavioral support. Nine studies and 5 review papers published between 1996 and 2000 were included in their review. The behavior problems typically addressed were aggression and destruction, disruption and tantrums, self-injury, and stereotypy. The behavioral interventions were found to reduce problem behaviors at least 80% in 50% of the comparisons. The interventions most effective were those developed through functional analysis of physiological factors affecting behaviors and the antecedents to and consequences of problem behaviors. Behavioral techniques of reinforcement,

punishment, and extinction all appeared to be effective. This review demonstrated that analysis of the behavior problem to identify the focus for intervention is essential to effectively reduce problem behaviors. This review also supports the positive effects of modifying the social and physical environment to prevent antecedents to problems behaviors and of consistently reinforcing appropriate behaviors. Functional analysis and environment modification are integral to occupational therapy approaches.

Discussion

In evidence-based practice, research is analyzed and interpreted to determine what interventions are effective to achieve which outcomes (Law, 2002). The practitioner's selection of intervention methods not only is based on the evidence but also is determined by factors such as the client's preferences, the setting where services are provided (e.g., home-based, center-based, school), the resources available, the family's preference and stage of life, and the occupational therapy practitioner's experiences and expertise. All of these variables need to be considered when applying the results of an evidence-based review of the literature.

Although the studies were based on different theoretic frames of reference, several themes of importance to occupational therapy emerged. This discussion focuses on the themes that threaded through the 49 studies and are relevant to occupational therapist practitioners in both direct service and supportive team roles.

Developing individualized interventions through analysis of performance and behavior is essential to successful outcomes. Analysis of the child's performance includes (1) assessing developmental level (Rogers & DiLalla, 1991), (2) analyzing physiological factors such as sensory processing that influence behaviors (Baranek, 2002; Greenspan & Wieder, 1997), (3) identifying appropriate and maladaptive behaviors and the environmental influences on those behaviors (Horner et al., 2002), (4) determining pivotal behaviors that form a foundation for learning (Koegel et al., 1996), and (5) analyzing which variables promote or inhibit best performance (Panerai et al., 2002). Virtually all of the interventions used individualized assessment to determine the appropriate developmental level for activities and the best methods for facilitating performance. Most interventions considered the child's strengths, such as those in visual processing (Ozonoff & Cathcart, 1998), while considering the child's limitations, such as those in communication and social interaction (e.g., Hwang & Hughes, 2000). Effective interventions use comprehensive analysis of performance that considers both internal and external influences. These findings support the occupational therapy process of performance analysis and development of interventions that use the child's

individual strengths when remediating performance delays or deficits (Law & Baum, 2005).

Children's social interaction improves when adults (parents or therapists) respond positively, establish eye contact, reinforce the child's communication attempts, wait for the child to respond to a request, and modify the environment to elicit communication attempts (Greenspan & Wieder, 1997; Hwang & Hughes, 2000). These techniques promote pivotal behaviors such as joint attention, initiative, persistence, interest, cooperation, and positive affect, abilities that are foundational to learning (Koegel et al., 1996; Mahoney & Perales, 2005). Pivotal behavior interventions emphasize the occupational therapist's responsiveness to the child and sensitivity to the child's cues. In a year-long study of young children with pervasive developmental disorders, Mahoney and Perales (2005) demonstrated that acquisition of pivotal behaviors contributed to developmental progress. In another study that taught mothers to encourage their children to develop new behaviors in the context of already mastered skills and to use natural reinforcers, Koegel et al. (1996) found that positive parent-child interactions were associated with increases in children's pivotal responses. These studies suggest that, rather than emphasizing interventions that help children acquire specific skills and behaviors, occupational therapists should coach parents in methods that facilitate the child's ability to engage in and attend to an activity, relate to others through eye contact, and learn turn-taking and sharing. These behaviors are fostered when occupational therapists help parents select a "just-right" activity and establish positive interaction with the child.

Occupational therapists establish environments that challenge and motivate the child and reinforce the child's engagement in the activity. The review by Hwang and Hughes (2000) reported positive effects in social interaction when professionals (1) arranged the environment to increase a child's interest and prompt social interaction; (2) presented a dilemma that the child needed to solve (e.g., favorite toy is out of reach); (3) waited for the child's response, even when it was delayed; (4) imitated the child's response; and (5) provided positive social reinforcement. Evidence for the effectiveness of these strategies in promoting social interaction was demonstrated by Dawson and Galpert (1990), Field et al. (2001), and Greenspan and Wieder (1997). These strategies can be embedded in occupational therapy intervention by creating activities that promote social interaction (e.g., sharing and cooperation), supporting the child as he or she works through a dilemma, imitating the child, and waiting for a response. These strategies differ from behavioral approaches in which interventionists give directives and rewards, because the occupational therapist establishes a natural play scenario, the child initiates the interaction, and then the therapist follows the child's lead.

Children with ASD benefit from structured activities with typically developing children who can initiate communication, provide modeling, and adapt their method of interaction to enable communication. Although behaviors improve when paired with typically developing children, they do not improve when children with ASD are paired with children with developmental delays (Legoff, 2004; Schleien et al., 1990, 1995; Smith, Lovaas, & Lovaas, 2002). Typically developing children provide excellent models and initiate social interaction; however, the effectiveness of using typical peers is based on intervention methods in which professionals facilitate the interactions. Rogers and DiLalla (1991) described methods for promoting interaction among children with autism and children who were developing typically by placing them in proximity and requiring an interaction to meet a shared goal. In this study, adults prompted social interaction and helped the children understand each others' emotions and perspectives. Legoff (2004) found that typically developing peers were helpful in promoting cooperation and social interaction, but peers with behavioral disorders were not. This report noted that group interaction improved when siblings were included as role models and helpers because they were familiar with their sibling's behaviors. In the Schleien et al. (1995) study, typically developing children demonstrated positive interactions with children with autism when engaged in a structured, inclusive activity, but children with autism rarely initiated social interaction. Given minimal encouragement, children who are developing typically can learn to initiate social interaction with children with ASD, and this peer modeling intervention has been found to increase the social participation of children with ASD (Legoff, 2004; Schleien et al., 1995).

Two primary paradigms in which occupational therapists have supportive team roles have been widely researched: (1) intensive behavioral treatment (Cohen et al., 2006; Lovaas, 1987; Smith et al., 2000) and (2) relationship-based interventions (Greenspan & Wieder, 1997; Mahoney & Perales, 2005). Both approaches have been found to be effective; however, one may be better suited for a particular child and family, and the outcomes differ. EIBI or 40 hr/week of one-on-one discrete trial training has been shown to improve IQ and language performance in children with ASD (Lovaas, 1987; McEachie et al., 1993; Smith et al., 2000). Although behavioral interventions are successful in training children in basic academic and life skills concepts, it is not known how well these skills transfer into the natural environment, and the findings are mixed regarding changes in behavior (Smith et al., 2000). Barriers to widespread application are as follows: (1) time and resources required to implement a 30- to 40-hr/week intervention and (2) definition of the most appropriate candidates (Bassett, Green, & Kazanjian, 2000).

In one-on-one, individual difference, relationship-based intervention, the therapist coaches the parents to interact with their child in intensive play sessions in which the parent imitates the child and encourages problem solving and pretend play scenarios (Greenspan & Wieder, 1997). Although only Level II and III evidence is available, the reported effects are positive and significant. These include social-emotional growth, social interaction, and communication with less emphasis on academic performance (Greenspan & Wieder, 1997; Hwang & Hughes, 2000; Mahoney & Perales, 2005; Wieder & Greenspan, 2005). Both the intensive behavioral and the relationship-based interventions have documented higher success with higher level children. Occupational therapists provide consultation and direct intervention in both types of programs. They can provide guidance to parents as to what outcomes might be expected and what gains their child might achieve from each intervention. Information about the time and resources required and how the intervention is implemented is also helpful to parents' decision making.

When children exhibit problem behaviors, functional analysis is essential to determine the basis for the behavior. Interventions shown to be effective (1) establish consistent environments that prevent the behaviors' occurrence; (2) eliminate or modify the antecedents; (3) eliminate the consequences that reinforce the problem behaviors; and (4) develop appropriate behaviors through modeling, guidance, cueing, instruction, and reinforcement (Horner et al., 2002). Behavior problems can be prevented by structuring the environment so it offers a consistent routine, provides methods for communication when verbal communication is deficit, and provides sensory experiences that optimize attention and arousal. In their systematic review of interventions for problem behavior in children with autism, Horner et al. (2002) found compelling evidence that functional analysis is essential to developing effective interventions. Ideally, proactive measures to prevent problem behaviors also prevent negative consequences for others in the environment. Occupational therapy practitioners can assist in implementing prevention strategies, including modifying the environment so that it facilitates optimal levels of arousal. Examples of occupational therapy preventive intervention include providing weighted vests to give calming proprioceptive input; establishing a quiet corner to calm children who are overaroused or overstimulated; and providing objects such as weighted blankets, bean bag chairs, rocking chairs, or spandex tunnels to help children organize, calm, feel secure, or experience quiet (Mailloux & Roley, 2004). In addition, occupational therapy practitioners reinforce the classroom rules, help children understand the rules using Social Stories (Reynhout & Carter, 2006) or other visual representations (Koegel et al., 1996) of desired behavior, and apply reinforcement or extinction behavioral

strategies (Horner et al., 2002) as developed by the child's educational team.

Limitations

Although other systematic reviews focus on only Level I, this comprehensive review used Level I through III evidence. The authors thought that a broader review that included Level II and III evidence would better represent current knowledge about the efficacy of autism interventions. Several of the approaches of greatest relevance to occupational therapists currently have only Level III evidence. This limitation suggests that because the level of scientific rigor varied among the studies, levels of evidence need to be considered in interpreting the results. Limitations that were common among all of the studies included lack of long-term evaluation of effects, use of focused evaluation instruments that did not measure children's occupations or participation, lack of randomization, inadequate measures of treatment fidelity, and inappropriate data analysis. Few of the studies were completed by occupational therapists; therefore, the authors attempted to use the lens of occupational therapy to interpret and apply the findings to occupational therapy practice.

Recommendations for Future Research

The research literature offers strong positive evidence for occupational therapists to use comprehensive, individualized analysis of the child's performance to develop the intervention strategies. The research evidence also supports the use of family-centered, interdisciplinary approaches. Many of the studies used play-based or activity-based interventions such as those implemented by occupational therapists.

Future research efforts of occupational therapy scholars should investigate the effects of environmental modifications for children with autism. Because these children respond to highly structured approaches, particularly those that use visual input, modifying the environment to assist in structuring their activities is an element of many of the interventions. Given the importance of context to occupational therapists, innovative modifications to the environment should be further developed and researched.

Although sensory-based techniques have moderate to strong evidence of effectiveness, classic sensory integration approaches have minimal research evidence. These approaches should be the focus of future research evidence. Broad, comprehensive assessment that includes physiologic, occupational, and participation measures should be used in determining the effects of sensory integration interventions. In particular, the effectiveness of sensory integration interventions on children's social interactions and engagement in activities is of high priority given the importance of these

skills to children's social participation and the potential of sensory integration to affect these performance domains.

Studies of interventions to promote adolescents' and young adults' success in work and independent living were virtually absent from the research literature. Work and community living skills are areas to which occupational therapists contribute and are of highest priority as people with ASD as they become adults. Interventions to promote work performance and community living are appropriate emphases for occupational therapists in both practice and research.

Conclusion

Occupational therapy is well aligned with the philosophical and conceptual basis of the interventions for ASD that have been researched and have demonstrated effectiveness; however, our contribution to these interventions is not apparent and certainly not visible to the public. Participation and leadership in research of autism should be a priority for occupational therapists who work with children with ASD and occupational therapy scholars. Important strides in developing efficacious interventions for autism have been made, and occupational therapy researchers should increase their contribution to this positive momentum. ▲

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