Education and Training in Developmental Disabilities, 2009, 44(3), 318–342

Evidence-Based Social Skills Interventions for Children with Autism: A Meta-analysis

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Abstract: The purpose of this study was to provide a synthesis of research studies published in the last ten years on interventions to increase social skills for children and adolescents with ASD, examine the outcomes of these studies and evaluate whether a given intervention meets the criteria for evidence-based practice. Thirty-eight studies were included in this review, of which 36 were single subject research studies and 2 group experimental studies. Results varied widely both between intervention types, and with the different studies within each intervention type. While Social Stories, Peer-Mediated, and Video-Modeling all met the criteria for evidence-based, a closer look at percentage of nonoverlapping data points (PND) shows that only Video-Modeling meets criteria for being evidence-based as well as demonstrating high effectiveness as an intervention strategy.

Interacting with one's peers can have a significant positive impact on the lives of individuals with disabilities, allowing them to build and participate more fully in their communities. Numerous interventions to teach social skills have been developed over the years (Carter & Hughes, 2005, Vaughn, et al., 2003, White, Keonig, & Scahill, 2007). However, many of these methods do not meet the requirements for evidence-based practice. New regulations in the reauthorization of IDEA in 2004 require that evidence-based practices be used to ensure individuals with disabilities receive the highest quality instruction.

Autism is a developmental disorder whose prevalence rate has been increasing dramatically over the past decade. One in 150 children in America today have an autism spectrum disorder (Centers for Disease Control and Prevention, 2007). The Autism Society of America (ASA) estimates that 1.5 million Americans and their families are now affected. In fact, autism is growing at a startling rate of 10-17 percent per year, and has become a national health crisis, costing the U.S. at least $35 billion annually (Autism Society of America, 2007).

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Deficits in social skills are one of the core features of autism spectrum disorders (ASD), and are a major source of impairment regardless of the intellectual or language ability of persons with ASD (Carter, Davis, Klin, & Volkmar, 2005). Individuals having better social skills are more likely to be accepted in integrated settings, live more independently, and work in integrated settings (Scheuermann & Webber, 2002). However, treating the social deficits of individuals with ASD remains a challenge (Weiss & Harris, 2001).

There have been many interventions used to teach social skills to individuals with ASD. These include social stories (e.g. Delano & Snell, 2006), peer-mediated strategies, (e.g. Laushey & Heflin, 2000), video modeling (e.g. Paterson & Arco, 2007), cognitive behavioral training (e.g. Bock, 2007), pivotal response training (e.g. Jones & Freely, 2007), Theory of Mind (e.g. Chin, Bernard-Opitz, 2000), among others. Additionally, a number of meta-analyses have looked at social skills training for individuals with ASD (Bellini & Akullian, 2007; Carter & Hughes, 2005; Cook,

Gresham, Kern, Barreras, Thornton, & Crews, 2008; Hwang & Hughes, 2000; Vaughn et al., 2003; White et al., 2007). None of this research has discussed whether the studies met criteria for being evidence-based practice.

Defining Evidence-Based Practices

National policies, such as No Child Left Behind (NCLB) require that teachers use evidence-based practices in their classrooms. Also, new regulations in the reauthorization of IDEA in 2004 require that evidence-based practices be used to ensure individuals with disabilities receive the highest quality instruction. However, there has never been a clear definition of what evidence-based practice is. Therefore, in January 2003, the Council for Exceptional Children (CEC) Division for Research established a task force to address the issue of evidence-based practices. A special issue of Exceptional Children (2005) was dedicated to establishing criteria for evidence-based practice in special education.

First, let's clarify what a practice is. According to Horner, Carr, Halle, McGee, and Wolery (2005), a "practice refers to a curriculum, behavioral intervention, systems change, or educational approach designed for use by families, educators, or students with the express expectation that implementation will result in measurable, educational, social, behavioral, or physical benefit." (p. 175)

In the 2005 special issue of Exceptional Children, Odom et al. set the context for the development of research quality indicators and guidelines for evidence of effective practices provided by different methodologies in special education, including group experimental or quasi-experimental research, single subject research, correlational research and qualitative research. For the purpose of this article, we will focus on two types of research methodologies: group experimental or quasi-experimental and single subject research. These two methodologies are largely used to identify cause-effect relationships between interventions and target behaviors, therefore, they are more appropriate for identifying evidence-based practices.

Specifically, for group experimental and quasi-experimental research articles and reports, Gersten et al. (2005) presented the following quality indicators: (1) participants in a given study are sufficiently discussed and their disability conditions are confirmed; (2) random assignment to study conditions are attempted and when randomization is not feasible, other alternatives are used to ensure participants are comparable across conditions; (3) sufficient information is provided regarding the interventionists and procedures implemented to ensure they are comparable across conditions; (4) intervention strategies are implemented with fidelity, (5) multiple outcome measures are used to capture the intervention's effect, (6) data analysis include effect size calculations in addition to inferential statistics (p. 152).

Furthermore, the panel suggested that a practice is considered evidence-based "when there are at least four acceptable quality studies or two high quality studies that support the practice and the weighted effect size is significantly greater than zero." (Gersten et. al., 2005, p. 162)

When evaluating research studies using the single subject methodology, Horner et al. (2005) stated that "single-subject research documents a practice as evidence based when (a) the practice is operationally defined, (b) the context in which the practice is to be used is defined; (c) the practice is implemented with fidelity; (d) results from single subject research document the practice to be functionally related to change in dependent measures, and (e) the experimental effects are replicated across a sufficient number of studies, researchers, and participants to allow confidence in the findings" (p. 175-176).

Additionally, documentation of an evidence-based practice typically requires multiple single subject studies. "A practice may be considered evidence-based when (a) minimum of five single subject studies that meet minimally acceptable methodological criteria and document experimental control have been published in peer-reviewed journals, (b) the studies are conducted by at least three different researchers across at least three different geographical locations, and (c) the five or more studies include a total of at least 20 participants" (Horner et al., 2005, p.176).

Although there have been a few review articles published on this topic in recent years (e.g. Matson, Matson, & Rivet, 2007; McCon-

nell, 2002; Rogers, 2000; Weiss & Harris, 2001), they tend to be more descriptive of the various interventions and lack quantitative evaluations of treatment effectiveness, that is, the researchers relied on the conclusions drawn by the studies' authors. In addition, these qualitative reviews do not compare treatment effectiveness across different intervention strategies. Furthermore, they fail to address the critical issue of evidence-based practices. The purpose of this study was to provide a synthesis of research studies published in the last ten years on interventions to increase social skills for children and adolescents with ASD, examine the outcomes of these studies and evaluate whether a given intervention meets the criteria for evidence-based practice.

Method

A comprehensive review of the literature was conducted using the following procedures. First, an electronic search was conducted for studies published between 1997 and 2008 August using the Educational Resources Information Center (ERIC) and PsycINFO databases. Searches were carried out using a combination of the following descriptors: *autism, autism spectrum disorder, ASD, social skills, social behavior, social development, conversational skills, play skills, social initiations, requesting, social responses, social interactions, social relationships, joint attention, eye contact, video modeling, peer-mediated interventions, videotape modeling, pivotal response training, theory of mind, cognitive behavioral training, incidental teaching, social stories, perspective taking, and naturalistic teaching.* Second, a manual search was conducted with the following peer-reviewed journals: *Research and Practice for Persons with Severe Disabilities, Journal of Applied Behavior Analysis, Exceptional Children, Education and Training in Developmental Disabilities, American Journal on Mental Retardation, and Focus on Autism and Other Developmental Disabilities.* In all, 104 studies were located in this initial search of journal articles.

Studies were selected for review based on the following criteria. First, participants must have been identified as having ASD between the age of birth and 21. Second, study participants were students receiving special education services either at home or in school settings. Studies conducted exclusively in community-based settings, employment settings and other settings that were not clearly described were excluded from this synthesis. Third, the study must have used outcome measures that targeted social skills. Studies that measured functional skills such as daily living skills, reduction of problem behaviors, or non-social communication skills were not included. Fourth, the study must have assessed the effectiveness of social skill interventions. Studies that used pharmacological interventions were excluded from this analysis. Fifth, the review comprised an empirical, intervention-based investigation and was published in a peer-reviewed journal between 1997 and 2008. Dissertation studies were not included in this synthesis. Sixth, the study must meet the criteria for evaluating evidence-based intervention strategies outlined by the Council for Exceptional Children Division for Research (2005). For the purpose of this review, only those studies that utilized group experimental or quasi-experimental and single subject research were evaluated and analyzed. For group designs, presentation of effect sizes along with inferential statistics is recommended. However, some studies included in this meta-analysis did not report the effect size of the intervention in the original study, they were included only when such calculation could be inferred based on available statistics reported. Effect sizes are expressed positively when change occurred in the predicted direction and negatively when changes were opposite to those predicted. An effect size of .20 is small, .50 moderate, and .80 large. The usually accepted minimum clinically acceptable effect size for educational interventions is 0.33 (McCartney & Rosenthal, 2000).

If a study uses single subject research design, the study must demonstrate experimental control through the use of multiple baseline, reversal or alternating treatment designs as outlined by the Council for Exceptional Children Division for Research (2005). Additionally, the study must present data in graphical displays that depicted individual data points as these graphical displays were critical for the calculation of PND (percentage of non-overlapping data points), the metric analysis employed in this meta-analysis. Scruggs, Mastropieri, and Castro (1987) suggested that "PND is the only major evaluative criterion that can consistently be applied in the largest

number of cases of single subject studies" (p. 27). PND is usually computed by dividing the number of treatment data points that exceeds the highest baseline data point in an expected direction by the total number of data points in the treatment phase. A PND between 91 and 100 is considered a highly effective intervention, between 71 and 90 moderately effective, between 51 and 70 mildly effective, and between 0 and 50, non-effective (Scruggs & Mastropieri, 1998).

Using these methods and criteria, we identified 38 studies for inclusion in this review, of which 36 were single subject research studies and 2 group experimental studies.

Classification

For the 36 single subject research studies, we used a coding system established by Mastropieri and Scruggs (1985-1986) and made modifications based on the criteria outlined by Horner et al. (2005). Each study was analyzed across the following categories: (1) participant characteristics, including the number of participants, diagnosis, settings, age and functional levels; (2) description of target behaviors and skills; (3) description of intervention; (4) research design; (5) intervention results including intervention, maintenance and follow-up, and generalization effects as measured by PND; and (6) confirmation of whether the study measured treatment integrity and social validity.

Interrater Agreement

To establish interrater reliability for the coding procedure and the PND analysis, the first author coded all the single subject studies and calculated the PND while the second author randomly selected 30% (12) of single subject studies, independently coded and calculated the PND for those studies. Interrater agreement was obtained by dividing the total number of agreements by the total number of agreements plus disagreements and multiplying by 100. The mean interrater agreement between the two authors was 97% (range 78%-100%).

Results

A summary of the participants, target behaviors, intervention strategies, and research design was constructed and presented in Table 1. Table 2 provides descriptive information on intervention results, study effect size or PND, maintenance, follow-up and generalization results, treatment integrity and social validity measures.

Overall Findings

Single subject designs were used to evaluate intervention effects in 36 studies and group designs were used in 2 studies. Five categories of different interventions emerged from these 38 studies, including Social Stories (n = 6), Peer Mediated (n = 9), Video Modeling (n = 11), Cognitive Behavior Training (n = 3), and Others (n = 9).

A total of 147 participants were included. Thirty-one studies used a variation of a multiple baseline or probe design, five studies used a reversal design, and two studies used pretest and posttest with a control group design. Treatment integrity was reported in 14 studies, of which 11 reported agreement percentage, ranging from 77% to 100%. Social validity was measured in 16 studies.

Participants and Settings

Of the 147 participants with ASD, among the studies that reported on gender, 73 participants were boys, and 6 were girls. Additionally, seven studies reported participation of a total of 68 typical peers. Participants with ASD ranged in age from 2 to 17 years old. The vast majority of participants were between the ages of 6-12 (82 participants), with thirty participants being five years or younger, and three participants being over 12 years of age. Not all studies reported ages of participants.

The studies primarily took place in integrated settings at public schools. Some studies were conducted across more than one setting. Ten studies reported being conducted in integrated public school settings not otherwise specified, 9 in specialized class settings at a public school. Six studies reported lunch, hallway, or other integrated school settings, three studies took place in general education classroom settings. Four studies took place in home or community settings, three studies took place in private segregated settings, and one study took place in a private integrated setting.

TABLE 1

Evidence-based Social Skills Interventions: Method and Research Design

Study	*Participants/Settings*	*Target Behavior*	*Interventions*	*Research Design*
		Social Stories (n = 6)		
Sansosti & Powell-Smith (2006)	3 boys with Asperger Syndrome (Ages 9, 10, 11 yrs) 2 boys in integrated private schools 1 in private school for children with LD All three boys have average or above-average IQ	Sportsmanship Maintaining conversation Joining in	Social Story was read twice a day	Multiple-baseline across participants
Delano & Snell (2006)	3 boys with autism (Ages 6, 6, & 9) Integrated settings 6 typical peers (3 boys & 3 girls) served as training peers and play partners	Duration of appropriate social engagement behavior Frequency of 4 social skills: Seeking attention, initiating comments, initiating requests, contingent responses	Social Story was read once a day	Multiple-probe-across participants
Thiemann & Goldstein (2001)	5 boys with autism (Ages 6-12 yrs) 3 boys were fully integrated, 2 were integrated for 30% of the day 10 typical peers	4 target behaviors: contingent responses, securing attention, initiating comments, initiating requests	Social stories, pictorial written text cues, video feedback	Multiple baseline design across two or three behaviors
Barry & Burlew (2004)	1 7-yr-old girl & 1 8-yr-old boy with severe autism in self-contained setting	Prompting needed for choice making; appropriate play (with peers & materials)	Social stories*	ABCD multiple-baseline design across two subjects
Scattone, Tingstrom, & Wilczynski (2006)	3 boys 8-13 with ASD free time activities across the school day	Appropriate social interactions	Social Stories written to address initiations and responses for appropriate social interactions for target students during free time activities	Multiple baseline across participants
Dodd, Hupp, Jewell, & Krohn (2008)	2 boys, 9 & 12 yrs old with PDD-NOS both in inclusive settings Average IQ	Decrease excessive directions to siblings, increase compliments to siblings	Social Story	Multiple baseline across behaviors & multiple baseline across participants

(continued)

TABLE 1

Continued

Study	*Participants/Settings*	*Target Behavior*	*Interventions*	*Research Design*
		Peer Mediated (n = 9)		
Laushey & Heflin (2000)	2 boys, 5 yrs 1 with severe Autism; 1 with mild PDD-NOS Inclusive setting	Asking & responding Getting attention Waiting for turn Eye contact	Buddy System-Multiple peers as tutors	ABAB
Pierce & Schreibman (1997)	Two boys with autism; moderate and profound MR	Maintains interactions; Initiates conversation; Initiates play	Multiple peer use of pivotal response training	Multiple baseline design across peer trainers and across 2 participants
Hwang & Hughes (2000)	3 preschool boys with autism (32-43 months) play area in an early intervention program classroom	Frequency of eye contact; frequency of joint attention; frequency of motor imitation	Social interactive training strategies (peer-mediated): contingent imitation; naturally occurring reinforcement; expectant look; & environmental arrangement	Multiple baseline across participant
Petursdottir, McComas, McMaster, & Horner (2007)	One five-year old boy with ASD & DD; high functioning; Study took place in the special ed classroom	Social interaction	Peer-Assisted Learning Strategies; common stimuli activities; peer tutoring	ABA withdrawal and multiple baseline across peers
Loncola & Craig-Unkefer (2005)	5 boys & 1 girl with mild/moderate autism (ages 6-8) study took place in a sectioned off area of a large hallway in a public school with high % of children with autism	Peer directed commenting; language diversity & complexity	Two children with autism were paired and received the plan-play-report treatment simultaneously	Multiple baseline across three dyads
Garrison-Harrell, Kamps, & Kravits (1997)	3 primary grade students with autism and 15 typical peers study took place during scheduled play and academic times in regular education settings	Social interaction between target students and their peers, use of augmentative communication systems Collateral behaviors: expressive verbalizations, reduction of inappropriate behaviors, non-target peers use of communication system, peer acceptance	Augmentative communication training, peer training, implementing peer networks (cooperative group activities with augmentative communication system)	Multiple baseline probe design across settings, nested with multiple baseline across students with autism

(continued)

TABLE 1

Continued

Study	*Participants/Settings*	*Target Behavior*	*Interventions*	*Research Design*
Carter, Cushing, Clark, & Kennedy (2005)	3 students (2 with autism) ages 12, 13, & 17 6 general education students in classes with target students in a middle and high school English and science class.	Social interactions (acknowledgement of another student using verbal or nonverbal behaviors), coded for who they occurred with, and the quality of interaction; Contact and consistency with general education curriculum	Peer training to adapt class activities, provide instruction, implement behavior plans, provide frequent feedback, promote communication for the participating students with disabilities	ABAB, and BABA: working with 1 or 2 peers
Koegel, Werner, Vismara, & Koegel (2005)	2 primary grade children with autism 14 typically developing peers play dates occurring in natural settings	Synchronous reciprocal interactions, child affect	Contextually supported play dates: activities selected to be mutually reinforcing for both child with autism and typically developing peer, cooperative arrangements set up by adults within activities (participation of both critical to the activity)	Multiple baseline across participants
Harper, Symon, & Frea (2008)	2 boys, 8 and 9 yrs old with autism in inclusive settings	Gaining attention, # of turn taking exchanges, # of initiations to play	Triads were developed—with two peers and one target child with autism during recess; naturalistic intervention	Concurrent multiple baseline across participants
		Video Modeling (n = 11)		
Paterson & Arco (2007)	2 boys with autism (Ages 6 & 7 yrs) high functioning play room in the school's special education center	Appropriate verbal play behavior & motor play behavior; repetitive verbal play and motor play behavior	Video modeling (by male adult); social praise	Multiple baseline across play behavior with a withdrawal phase
Nikopoulos & Keenan (2007)	Experiment I: 3 boys with autism (Ages 6.5; 6.5; & 7) in a semi-naturalistic room of a special school	Experimenter I: Social initiation; reciprocal play; imitative response; object engagement; other behaviors	Video modeling (by a 10-yr old boy with LD & average social skills); Verbal instructions; modeling in vivo; Behavior rehearsal	Multiple baseline across subject

(continued)

TABLE 1

Continued

Study	*Participants/Settings*	*Target Behavior*	*Interventions*	*Research Design*
Nikopoulos & Keenan (2004)	3 boys with autism (btwn 7-9 yr) setting unspecified	Social initiation; reciprocal play behavior	Video modeling (by a peer)	Multiple baseline across subjects
Gena, Couloura, & Kymissis (2005)	3 preschool boys with autism (Ages 5, 4, 3 yr) Mild to moderate mental retardation; Home setting for each participant	Affective responses: showing sympathy; showing appreciation; showing disapproval	Video modeling (by a peer of the same age and sex); In-vivo modeling	Multiple baseline across subjects with a return to baseline
Hine & Wolery (2006)	2 girls with autism (Ages 30, 43 months) inclusive setting	Different types of pretend play actions performed	Video modeling (with adults hands only)	Multiple baseline across behaviors (gardening & cooking tasks) across two participants
Wert & Neisworth (2003)	4 boys with autism (Ages 5.5; 4.5; 4; 5 yrs) unspecified school setting	Spontaneous requests	Video self modeling	Multiple baseline across subjects
Simpson, Langone, & Ayres (2004)	2 boys and 2 girls with autism (Ages 5, 5, 6, & 6) All participants were included in general ed classroom for part of the day	Complying with teacher directions; greeting others; sharing materials	Embedded video modeling (by typical peers) and computer based instruction*	Multiple probe across participants
Charlop-Christy, Le, & Freeman (2000)	5 boys and 1 girl with autism (Ages 8, 7, 10, 11, & 7) after-school behavior therapy program therapy room	Subject 1: Expressive labeling of emotions Subject 2: Independent play Subject 3: Spontaneous greetings; oral comprehensions Subject 4: Conversational speech; cooperative play Subject 5: Social play	In vivo and video modeling (by familiar adults)	Multiple baseline across subjects; multiple baseline with child across two modeling conditions and within each modeling condition across two tasks
Apple, Billingsley, & Schwartz (2005)	Experiment I: 2 boys with Asperger's Syndrome (both 5 yrs) Study took place in integrated preschool classroom during free play time	Compliment-giving behaviors	Experiment I: 1) Video modeling 2) VM + reinforcement 3) reinforcement only Experiment II: Self-management	Multiple baseline across subjects

(continued)

TABLE 1

Continued

Study	*Participants/Settings*	*Target Behavior*	*Interventions*	*Research Design*
Buggy (2005)	2 students with autism during lunch, recess, and free time in a small inclusive school	Social initiations	Videotaped self-modeling, 3-minute video showing participants engaging in typical positive social interactions	Multiple baseline across participants
Charlop-Christy & Daneshvar (2003)	3 boys with autism, ages of 6, 6 and 9 yrs low functioning	Perspective taking	Video modeling of 5 first-order perspective taking tasks	Multiple baseline across children and within child across tasks
		Pivotal Response Training (n = 1)		
Jones & Feely (2007)	3 preschool age children with autism	Joint Attention: responding and initiating	PRT, discrete trial format*	Multiple probe design across two joint attention skills
		Theory of Mind (n = 1)		
Chin, Bernard-Opitz (2000)	3 high-functioning children with autism, 5-7 years old, primary caregivers, one peer who participated in the generalization sessions, participants' homes	Conversational skills, shared interest, contextually appropriate responses, false beliefs (ToM)	Initiating conversations, Turn-taking in conversation, listening, maintaining conversation topic, changing topic appropriately	Multiple baseline across participants
		Cognitive Behavioral Training (n = 3)		
Lopata, Thomeer, Volker, & Nida (2006)	21 boys with AD 6-13 years old 6-week summer treatment program to enhance social behaviors	Social Skills, Adaptability, and Atypicality from the BASC, parent rating scales (PRS) and teacher rating scales (TRS)	6 weeks of the treatment program 6 hrs/day, 5 days/week. 4 70-minute treatment cycles daily One group had a behavioral management point system with response cost	Pre and posttest design. 2 groups: Social Skills instruction only (SS) and Social Skills instruction and Behavioral Treatment (SS+BT)
Baumringer (2002)	15 high-functioning children with autism	Social cognition and emotional understanding, overt social functioning	Adapted social skills curriculum taught 3 hours/week over a 7 month period*	Pre-post test design: Problem solving measure, Emotion inventory, Observations of Social Interaction, and Social Skills Rating (SSRS-T)
Bock (2007)	4 boys 9-10 years old elementary school where students attended: social studies cooperative group activities, noon recess, and lunch	Participate in cooperative learning activities, play organized sport games, and visit with peers during lunch	Social-behavioral learning strategy intervention (SODA)*	Multiple baseline across settings

(continued)

TABLE 1

Continued

Study	*Participants/ Settings*	*Target Behavior*	*Interventions*	*Research Design*
		Others (n = 7)		
Krantz & McClannahan (1998)	3 boys with autism (ages 4-5) small classroom at the participants' school	Scripted interaction; elaborations, unscripted interaction	Textual cues were embedded in the child's activity schedules; script fading	Multiple baseline across participants
Nelson, McDonnell, Johnston, Crompton, Nelson (2007)	4 preschool children with autism (ages 3-4)	Play initiation; engagement time; play repertoire	Keys to Play	Multiple baseline probe
McGee & Daly (2007)	3 preschool boys with autism university based preschool, with majority of typically developing children	Two social phrases: "all right" and "you know what?"	Incidental teaching	Multiple baseline across participants
Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet (2002)	3 boys with autism 3-12 years old Sessions were conducted in empty training rooms, the child's classroom, and the child's home	Speech: spontaneous speech and imitation Social communicative: cooperative play, joint attention, requesting, initiation	PECS training	Multiple baseline across participants
Shabani et al. (2002)	3 kindergarten boys with autism, typically developing peers at school and home	Verbal initiations, and verbal responses to peer initiations	Tactile prompting device for initiating	ABAB
Gonzalez-Lopez & Kamps (1997)	4 children with autism, ages 5-7 years old, 12 typical kindergarten and first grade children in the same elementary school special education classroom	Behavior management skills for typical peers Greetings, using names and conversations, imitation and following instructions, sharing and turn-taking, asking for help	Social skills training using training scrips, social skills training plus reinforcement	Reversal design with two intervention conditions
Charlop-Christy & Kelso (2003)	3 boys with autism, ages 8, 8, and 11 verbal, literate	Conversational speech	Conversational Scripts, cue cards	Multiple baseline across subjects with embedded multiple probes within each child across conversations

* Interventions were implemented by classroom teachers, paraprofessionals or parents.

TABLE 2

Evidence-Based Social Skills Interventions: Results, Effects, Treatment Integrity

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
		Social Stories (n = 6)		
Sansosti & Powell-Smith (2006)	Increased target behavior (2/3) PND=59.57%	Follow-up data were collected two weeks after the treatment FPND=50% Maintenance results not reported	Two participants data were reported, 88% & 92% 3rd child's family failed to provide needed info	Yes
Delano & Snell (2006)	Improved performance on all target behaviors across all three participants (3/3) PND=90%	Intervention was gradually faded (2 phases) 2 participants demonstrated gains in their general ed classroom settings MPND=81.57%	Mean=93% (78%-100%)	Yes
Thiemann & Goldstein (2001)	3/4 target behaviors were obtained by 3 boys; 2/4 target behaviors were obtained by 2 boys PND=47%	2 boys generalized to untrained social behaviors; 1 generalized within classroom MPND=37.97%	Not reported	Yes. 7 gen ed teachers and 6 SLP graduate students who are blind to the study rated participants' performance pre-and post-treatment via 2-min video vignettes.
Barry & Burlew (2004)	Both participants made gains in making independent choices and play appropriately during free play time in the self-contained setting PND=100%	Generalization effects were reported via anecdotal evidence—the girl transitioned to a general ed classroom due to the significant gains in her social skills	Not reported	Not reported
Scattone, Tingstrom, & Wilczynski (2006)	Increase in appropriate social interactions for 2/3 participants PND=46.7%	None	100% for 2 students, 86% for 1 student	IRP-15 scores all in the acceptable range
Dodd, Hupp, Jewell, & Krohn (2008)	Increased target behaviors for both boys PND=60% (zero baseline)	Reported for only 1 subject MPND=100%	Participant 1=100%; Participant 2= 97.1%	Yes

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
		Peer Mediated (n = 9)		
Laushey & Heflin (2000)	Significant improvement in social skills for both children PND=100%	Only 1 participant reported follow up data in general ed classroom and he maintained the gains FPND=100% (1 child only)	Yes	Focus group was used to validate the DV & IV
Pierce & Schreibman (1997)	Both participants made significant gains in their social skills PND=71.01%	Both participants generalized their gains into other settings with novel people as well MPND=66.67% FPND=71.05%	Not reported	Not reported
Hwang & Hughes (2000)	3/3 participants increased target behavior; PND=72.22%	Generalization of eye contact and motor imitation were found across new setting and different partner; joint attention rarely generalized	Yes	Yes
Petursdottir, McComas, McMaster, & Horner (2007)	No effects of peer tutoring alone on social interactions. Adding play-related common stimuli to the peer-tutoring activity increased social interactions during free play. PND=36.17%	Not reported	81% (range 56%-92%) for the K-PALS; 91% (range 86-96%) for common stimuli activities	Yes
Loncola & Craig-Unkefer (2005)	All dependent variables improved across all subjects PND=56.72%	Not reported	98% (80%-100%)	Not reported

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
Garrison-Harrell, Kamps & Kravits (1997)	Increased duration of peer interactions across settings, increased use of augmentative communication system, some increase in verbalizations, increase in peer acceptance Frequency of interactions PND=48% Duration of interactions PND= 95%	None	Not reported	Not reported
Carter, Cushing, Clark, & Kennedy (2005)	Higher level of social interactions, and contact with the general curriculum when supported by 2 peers PND=35.09%	None	Not reported	Not reported
Koegel, Werner, Vismara, & Koegel (2005)	Significant increases in unprompted synchronous reciprocal interactions PND=100%	None	Not reported	Frequency of reciprocal invitations—more invitations extended by peers after treatment
Harper, Symon, & Frea (2008)	Both participants improved their social peer interactions during recess PND=75% (zero baseline)	Yes GPND=100%	Yes Data were reported in a table, ranging from 78%-100%	Yes but through anecdotal reports

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
		Video Modeling (n = 11)		
Paterson & Arco (2007)	Both participants increased their appropriate verbal and motor play behavior across toys; their repetitive verbal and motor play behavior decreased; PND=100%	1 boy generalized motor play with three related toys; follow up data were recorded 1 week after treatment was withdrawn for both boys FPND=100%	Not reported	Not reported
Nikopoulos & Keenan (2007)	Experiment I: mixed results across subjects and behaviors PND=90.57%	Generalization to a novel peer was measured for all three participants; Follow up data were taken at 1- and 2-months. FPND=100%	Not reported	The social validation of the treatment outcomes was assessed by ten mothers of school-aged children.
Nikopoulos & Keenan (2004)	All participants increased the duration of reciprocal play; social initiation improvement results were mixed PND=72.41%	Follow-up tests conducted at 1 and 3 months after the study FPND=100%	Not reported	Not reported
Gena, Couloura, & Kymissis (2005)	All 3 participants increased their affective categories In vivo modeling PND=88% Video modeling PND=79%	Follow-up at 1- and 3-months GPND=100% FPND=100%	Not reported	Not reported
Hine & Wolery (2006)	Both participants showed improvement in both pretend play behaviors PND=70.45%	Generalization across materials and across settings were measured MPND=100%	M=95% (83.3% to 100%)	Yes

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
Wert & Neisworth (2003)	All 4 participants showed significant improvement PND=97%	Yes MPND=100%	Not reported	Not reported
Simpson, Langone, & Ayres (2004)	All 4 participants showed significant improvement PND=97.30%	Not reported	Not reported	Not reported
Charlop-Christy, Le, & Freeman (2000)	Overall, video modeling led to quicker acquisition of skills than in vivo modeling. In vivo modeling PND=72.88% Video modeling PND=76.92%	Generalization probes across different stimuli, persons, and setting were conducted during baseline and also 3 to 5 days after criterion performance was demonstrated in treatment. In vivo GPND=58.82% Video GPND=84.62%	Yes. For the in vivo condition, the modeling sessions were videotaped and rated at 99%.	Not reported
Apple, Billingsley, & Schwartz (2005)	During video modeling, both participants were able to acquire the skills of compliment-giving responses Experiment II: Self-management increased subjects' independence in monitoring their own compliment-giving behavior Video Modeling Respond to others PND=100% Initiate PND=0%	Experiment I Initiation FPND=20% Response FPND=100%	M=90% (84%-97%)	Parents and teachers reports

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
	VM+ Reinforcement Initiation PND=100% Response PND=100% Reinforcement Initiation PND=100% Response PND=100% (Zero baseline) Experiment #2 Video Modeling Respond PND=100% Initiate PND=0% Self Management Initiation PND=100% Response PND=100%			
Buggy (2005)	Gains made in frequency of social initiations (0 to 4.4; and .17 to 4.25 initiations/day) PND=90.91% (Zero baseline for one participant)	Results maintained MPND=100% FPND=100%	Not reported	Not reported
Charlop-Christy & Daneshvar (2003)	Various gains made by all participants PND=52.21% (Zero baseline)	Wider range of generalizations were reported GPND=40.35% MPND=46.67%	Not reported	Not reported

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
		Pivotal Response Training (n = 1)		
Jones & Feely, (2007)	All 3 children achieved mastery (90% independent correct responding, across 2 consecutive sessions and days) PND=66.11%	Performance continued during 6-30 maintenance sessions, and during generalization probes GPND=100%	Video-taped recordings: 86-97% presentation 80-100% prompting 77-96% consequences	Not reported
		Theory of Mind (n = 1)		
Chin, Bernard-Opitz (2000)	Increased time spent in shared interest in conversations Increased percentage of responses appropriate to context of conversation Score of 0 for all students on first or second order False Belief tasks. PND=80.77%	1 child increased shared interest time, percentage of contextually appropriate responses with typically developing peer GPND=100%	Not reported	Increased eye contact, maintaining topic, and taking turns according to social validity assessment questionnaire
		Cognitive Behavioral Training (n = 3)		
Lopata, Thomeer, Volker, & Nida (2006)	Significant main effects were found from parent ratings for general improvement for social skills, adaptability, and atypicality. Staff ratings had significant improvements for social skill, but nonsignificant ratings for adaptability, and significant ratings in the opposite direction for atypicality Effect size social skills: .24 Effect size adaptability: .59 Effect size atypicality: .39	None	Not reported	Not reported

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
Baumringer (2002)	Post treatment results indicated significantly greater ability to suggest relevant solutions, higher number of social solutions, few non-social solutions Significant improvement in knowledge of emotions Significant main effects for initiating positive interactions, and responding positively to peers Significantly higher post-treatment scores on cooperation and assertion on SSRS-T Effect size positive interactions: 1.24 Effect size cooperation: .47 Effect size assertion: .69	None	Not reported	Not reported
Bock (2007)	Increase in participation in cooperative learning activities, playing organized sport games at recess, and visiting with peers at lunch for all students PND=100%	Maintenance probes 1/month for 5 months indicated high performance levels maintained after intervention training MPND=100%	Not reported	Not reported
		Others (n = 7)		
Krantz & McClannahan (1998)	Verbal elaborations and unscripted interaction increased; PND=83.52% (Zero baseline)	Gains maintained to new interactions/activities GPND=100%	Not reported	Not reported

(continued)

TABLE 2

Continued

Study	*Results*	*Maintenance/Follow up/ Generalization*	*Treatment Integrity*	*Social Validity Measures*
Nelson, McDonnell, Johnston, Crompton, Nelson (2007)	Increased initiation & engagement duration; improved sophistication PND=48.57%	Initiations are generalized within the classroom MPND=100%	Not reported	Yes
McGee & Daly (2007)	Children were able to acquire target social phrases, and transfer use of those phrases to situations where there were no prompts or reinforcement for their use PND=36.78% (Zero baseline)	Generalization probes occurred during free-play activities at least 2 hrs after teaching sessions GPND=44.44%	Teaching sessions videotaped, monitored occurrences of procedural errors	Solicited opinions from local area preschool teachers using questionnaires
Charlop-Christy, Carpenter, Le, LeBlanc, & Kellet (2002)	Increases in spontaneous speech and imitation Increases in initiations, requests, and joint attention MLU PND=27.78% Cooperative Play, Joint Attention, Eye Contact & Combined Frequency of Initiation and Requests PND=76.32%	Results maintained during post training follow-up MLU FPND=100% Cooperative Play, Joint Attention, Eye Contact & Combined Initiations and Requests FPND=96.67%	Not reported	Not reported
Shabani et al. (2002)	Increases in verbal initiations and responses PND=89.13%	Partial maintenance of behavior during prompt-fading MPND=100%	Not reported	Not reported
Gonzalez-Lopez & Kamps (1997)	Increased frequency and duration of interactions for all students Frequency of interactions PND = 59% Duration of interactions PND=67%	None	Not reported	Not reported
Charlop-Christy & Kelso (2003)	All participants made gains PND=89.47%	Generalization probes were taken with different conversational partners, settings and topics GPND=72%	Not reported	Not reported

Target Behaviors

A number of social behaviors were targeted across the studies; many studies targeted more than one behavior. Maintaining conversation and/or appropriate social behavior was targeted in 28 studies, 17 studies targeted initiating conversations or social behavior (including greetings and requests), 5 studies targeted initiating play. Eight studies targeted appropriate play skills (including turn-taking), two studies targeted eye contact, and two studies targeted perspective-taking.

Research Designs

The vast majority of studies (31) utilized a multiple baseline design. Twenty-four studies were conducted across participants, six studies were conducted across behaviors, three studies were conducted across settings, three studies were conducted across other individuals, and two studies were conducted across tasks. Some of the studies were conducted across multiple categories within the study.

Of the other seven studies, five utilized the ABAB or reversal design, and two studies utilized the group experimental design. Both of the experimental studies followed a pre-post-test format with a control group.

Outcome Measures across Interventions

Social Stories. Six studies used Social Stories to teach social skills. The PND scores ranged from 46.7% to 100% with a mean of 67.21%, which represents questionable effectiveness as an intervention according to Scruggs and Mastropieri (1998). Although Social Stories met the criteria for evidence-based practice according to Horner et al. (2005), the effectiveness of Social Stories as an intervention for improving social skills is questionable due to the low PND scores.

Peer Mediated. A total of nine studies in this review used peer mediated strategies. The PND scores ranged from 35.09% to 100% with a mean of 60.69%, which represents low to questionable effectiveness. Twenty-four participants were included in these studies. The studies were conducted by 25 researchers across nine geographic areas. However, the effectiveness of peer mediated strategies to improve social skills in children with autism remains to be questionable due to the low PND scores.

Video Modeling. There were eleven studies used video modeling to teach social skills. The PND scores ranged from 50% to 100% with a mean of 84.25%, which represents effective intervention. Video Modeling met the criteria for evidence-based intervention and its PND scores shows that it is an effective intervention for teaching social skills to children with autism.

Cognitive Behavioral Training. Three studies were included in this category to examine the effects of cognitive behavior training on social skills, two of which were group experimental designs. We used available data reported in the original studies to obtain the effect size due to the absence of such results in the original studies. The effect size for Lopata et al (2006) ranged from .59-.24 indicating moderate to mild effects, while the effect size for Baumringer (2002) ranged from 1.24-.47 indicating high to moderate effects. The third study used a multiple baseline across settings design. The PND for intervention was calculated at 100%, which is very promising. However, more studies are needed to confirm the efficacy of cognitive behavioral training.

Others. In this category, most of the interventions were represented by only one study, i.e. pivotal response training ($n = 1$), Theory of Mind (ToM, $n = 1$), scripts and cue cards ($n = 2$), Keys to Play ($n = 1$), incidental teaching ($n = 1$), PECS training ($n = 1$), tactile prompting device ($n = 1$) and social skills training with scripts and reinforcement ($n = 1$). Even though some of the studies reported fairly promising PND scores, (e.g. ToM PND = 80.77%, indicating an effective intervention), more studies are needed with more participants and by different researchers to further evaluate their effectiveness as evidence-based and effective interventions.

Intervention Maintenance and Generalization Effects

Twelve out of 36 studies reported the maintenance effects of the intervention. The PND scores ranged from 38% to 100%, with a mean of 78.5%. Nine studies reported the generalization effects of the intervention. The PND

scores ranged from 40% to 100% with a mean of 80.95%. In addition, nine studies reported the follow-up data of the intervention. The PND scores ranged from 60% to 100%, with a mean of 92.15%. However, these averages were obtained across five categories of interventions, making it impossible to conclude whether the impact of individual interventions was effectively maintained and generalized due to limited number of studies in each category reporting such results.

Treatment Integrity

Fourteen studies assessed the extent to which intervention conditions were implemented as intended; eleven studies actually reported numerical data on treatment integrity. Researchers in 3 studies discussed that treatment integrity was monitored but provided no numerical data. In studies in which treatment integrity was reported, interventions were implemented with a high degree of fidelity. Because most studies did not include assessment of treatment integrity, we find it difficult to draw definite conclusions that the changes in the target behaviors are the results of the interventions. Also because most studies reviewed in this article were implemented by researchers, additional research is needed to determine whether interventions can be implemented with high fidelity by teachers, parents, or others. Otherwise, the generality of these interventions for use in the real school settings remains to be unclear.

Social Validity

Measures of social validity were reported in 16 studies. Most studies provided evidence for the social importance of intervention outcomes. Assessment of social validity was obtained either through interviews or questionnaires. It is important that parents and classroom teachers believe that the selected intervention strategies are effective and appropriate. If the intervention lacks social validity, parents and teachers are less likely to exert the necessary effort to implement the intervention, thus diminishing the intervention fidelity.

Discussion

Results varied widely both between intervention types, and within each intervention type. While Social Stories, Peer-Mediated, and Video-Modeling interventions all met the criteria for evidence-based practices according to Horner et al. (2005), a closer look at PND scores shows that only Video-Modeling meets criteria for being evidence-based as well as demonstrating high effectiveness as an intervention strategy. The PND scores of two of the six Social Stories intervention studies (Barry & Burlew, 2004; Delano & Snell, 2006), and three of the nine Peer-Mediated intervention studies (Garrison-Harrell, Kamps, & Kravits, 1997; Koegel, Werner, Vismara, & Koegel, 2005; Laushey & Heflin, 2000), demonstrated high effectiveness. Looking more closely at those highly effective studies could provide clues to implementing interventions in ways that will be effective. Cognitive behavioral training is another intervention that shows great promise; more research is needed in this area to demonstrate both its status as an evidence-based practice, and its overall effectiveness.

Zero Baseline Effects

Seven out of the 36 single subject studies reported zero baseline, by which is meant all baseline data are equal to zero. Such data are problematic due to the fact that a minor effect could result in relatively high levels of nonoverlapping data. In the case of zero baselines, it is often difficult to believe that "the subject was exhibiting no task-relevant behavior at all. It often seems that the observational measure was not sensitive to relevant levels of behavior that were being examined" (Scruggs, et al., 1987, p. 30). Therefore, during final data analysis, we need to be more cognizant whether a specific treatment was effective only in the presence of "zero baseline" data. In such case, conclusions regarding the effectiveness of a particular treatment should be interpreted with caution.

Implications for Practice

This review described a variety of interventions that have been developed and evaluated

to promote social skills in children with autism spectrum disorders. The results of the present study are consistent with those of previous meta-analysis indicating that social skills interventions are minimally effective for children with ASD (Bellini et al. 2007; Vaughn et al., 2003). The exception to this is video modeling; that intervention was shown to meet the criteria for evidence based practice, as well as being highly effective. Practitioners implementing video-modeling as a method for teaching social skills can do so with greater confidence of its effectiveness. While social stories and peer-mediated strategies can be said to be evidence-based practices, practitioners should monitor these strategies closely when implementing them as they may have limited effectiveness. Other strategies should be implemented carefully, with the understanding that they have not met criteria as evidence-based practices, and require continuous monitoring for effectiveness.

Most of studies included in this review were conducted by researchers with a few exceptions that were implemented by classroom teachers, paraprofessionals or parents. However, social skills training in general is carried out by teachers and parents in integrated settings. If the interventions implemented by professional researchers yield mixed results, it would be a real challenge for classroom teachers and parents with limited resources and time to achieve the same or better outcomes.

Limitations

This synthesis only evaluated social skills interventions for children with ASD published between 1997 and August 2008. Evaluating studies over a longer period of time may have resulted in more interventions meeting the criteria for evidence-based practice, or more studies demonstrating a higher level of effectiveness. However, the criteria for evidence-based practices were only recently established; studies done before 1997 would have been even more less likely to meet those criteria. We also only looked at studies that were primarily implemented in school-based settings; the effectiveness of these interventions on social skills in community settings or for adults with ASD cannot be determined from this meta-analysis.

Suggestions for Future Research

Although our initial search of the literature found 104 studies that targeted social skills, in the end only 38 of those met criteria to be evaluated as evidence-based practice, as well as allowing for the calculation of treatment effects. Future research in this area should be planned and implemented in such a way that meets the criteria for evidence-based practice, as well as reports treatment effects.

Most of the studies targeted students between the ages of 5-12; many of the remaining studies targeted preschool children. Only three studies were implemented with individuals over 12 years of age. Studies targeting these older children would be beneficial in determining if particular interventions are more effective with this age group.

Generalization of skills is an integral component of social skills interventions. Future studies are needed to examine the generalization of skills across multiple settings and with multiple persons. Researchers and teachers should create an explicit plan for promoting generalization when developing a social skills intervention.

Single subject designs were used to evaluate intervention effects in 36 out of the 38 studies included in this review. Multiple baseline designs were utilized in almost all of the studies to establish the experimental control. Although such designs are well-suited to demonstrate analyses, certain limitations do apply—it does not allow for comparison of different interventions. Future research is needed to determine which intervention is most effective for which students. Compounding this limitation is the presence of near or at zero baseline performance by the participants in many studies. Because most social skills interventions are likely to boost social interaction above the floor levels, comparative analysis can assist researchers in identifying which intervention achieves this objective most effectively.

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