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Interventions Addressing Social Impairment in Autism

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Abstract

Children with an autism spectrum disorder have significant impairment in social skills. This area of development has also been the focus of many intervention studies. In this article we review intervention studies published over the past two years. Three topical areas were addressed in current interventions: social skills knowledge, peer relationships, and joint attention/joint engagement. Younger children most often received interventions on joint attention/joint engagement and older, higher functioning children received interventions on social knowledge and peer relationship development. Both single subject research designs and group designs were reviewed. One advancement was that more randomized controlled trials were reported, as well as effectiveness trials in the community. Study quality was also rated. More group than single subject designs were rated as adequate or strong in quality. Overall, moderate to large effects were found for interventions targeting joint attention/joint engagement and peer relationships with mixed effects on interventions targeting social skills knowledge. Future studies should focus on isolating the active ingredients of interventions and include broader participant representation.

Keywords

Interventions; Social impairment; Autism; Autism spectrum disorder; Social skills; Randomized controlled trials; Single subject research designs; Joint attention; Joint engagement; Peer relationships; Social knowledge; Psychiatry

Introduction

Social impairment may be the most complex and impenetrable core challenge facing children with autism [1, 2]. While many behavioral and comprehensive interventions have shown promise in addressing a range of developmental difficulties of children with autism including cognitive ability and functional behavior, these interventions have had the least effect on improving social behavior. The National Institute of Mental Health [3] and Interagency Autism Coordinating Committee [4] have identified the development of interventions to address social impairment in individuals with autism as a high priority.

Intervening to improve social impairment in autism can be perplexing. While it is common to target social behaviors that are absent/limited (e.g., initiations) or social behaviors that occur so frequently they become inappropriate (e.g., excessive question asking), interventions may also be required to target the quality of social behaviors. That is, a child may initiate social interactions with others frequently, but the quality of the initiation is so poor that the initiation

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is ignored or avoided. Also puzzling is the pattern of strengths and weaknesses in social skills, prompting Frith and Happe [5] to describe this pattern as 'fine cuts along a hidden seam'. Children can be quite good, for example, at requesting help via gestures, but quite poor at commenting or sharing interest using gesture. Both types of gestures develop at the same time in typically developing children, but sharing gestures require more consideration of others than mere requesting skills [6]. Thus, children with autism present with qualitatively complex strengths and weaknesses, requiring interventions that are targeted, individualized, and that include flexible targets that change over time.

Social Impairment in Autism: What is the Problem?

The difficulties common for young children with ASD center on two key problems: a) their ability to engage jointly with others (joint attention/joint engagement), and b) the amount and quality of their interactive skills to enter into or maintain interactions with peers. Young children with autism are identified by their apparent lack of awareness of others, evidenced by little coordination of attention between an object or event and another person (*joint attention*). For example, they may be so focused on playing with a toy that it is difficult for another person to join in and share the play (lacking *joint engagement*). When young children do engage with others it is often to request help obtaining a favorite item. In community contexts such as the classroom or playground, the child with autism may be unaware of other children, instead playing in the sand alone, or running across the park. If the child is interested in other children, s/he may not have the skill set to begin or maintain an interaction.

Older children with autism, particularly those who are high functioning and in school continue to have significant social challenges, including a limited number of social encounters with others. Challenges in developing better social relationships have been linked to problems in recognizing subtle social cues and emotional states in others, and an inability to take the other's perspective, leading to egocentric responses in social situations. Children often report few friendships, and in adolescence endorse feelings of loneliness at school [7]. By their own account, developing friendships is often cited as the most important goal for children, adolescents and adults with ASD [8]. For the older child with ASD, major social difficulties center on a) skill development involving perception, knowledge and understanding of others, and b) development of peer relationships, including friendships.

Many interventions have been developed and tested over the past 20 years to address these impairments in younger and older children. Four reviews of these interventions published prior to 2010 [9–12] noted that most social skills interventions were tested in clinics with groups of children unfamiliar with each other. The social skills curricula in these programs had common elements (e.g., greetings, making eye-contact, initiating conversations) but there was not a uniformly accepted set of curricular skills, nor were there data suggesting that skills learned in these groups were transferred to natural contexts for children, such as school [10–11]. A concern has been that the skills addressed in these programs may not be the actual skills needed in everyday interactions at school [9]. In other words, polite manners (e.g., shaking hands, making eye-contact) may be useful when introduced to an adult but may be less typical when trying to enter a game or conversation on the playground. According to one review, two specific social skills interventions have sufficient evidence to be considered evidence based practices, social skills groups and video modeling [12]. Based on the state of the science, Reichow and Volkmar [12] suggested that future research needs to include parent-mediated social skills interventions for adolescents and adults, interventions for more cognitively impaired individuals, and interventions involving siblings. In the current review of social skills studies between 2010 and 2012, we note that interventions involving parents and siblings and including participants who are more cognitively impaired were published suggesting that the field of social skills intervention is rapidly expanding.

Methods

Search Strategy

Eight electronic databases covering education, medicine and psychology were searched in July 2012. The search was restricted to materials published in peer -reviewed journals between January 2010 and July 2012. Keyword search terms spanned three areas including those related to autism (autis* or pervasive develop* or Asperger*), social skills (social skill* or social interaction* or joint attention or social communication or social behavior*) and intervention (intervention or social skills training or parent* or peer* or teacher or para*).

Inclusion and exclusion criteria—A set of inclusion and exclusion criteria was applied to the manuscripts obtained from the search. Included studies:

1. Used a quantitative experimental design including group or single subject research designs (SSRDs). Studies using pre-experimental designs (e.g., one group pre/post, case studies) were excluded.
2. Included participants of any age diagnosed with an autism spectrum disorder including autistic disorder/autism, pervasive developmental disorder or Asperger's syndrome. Studies including a mix of participants with autism and participants with other diagnoses were excluded.
3. Examined an intervention for which a social skill was the primary outcome.
4. For studies using SSRD, graphical data for primary outcomes were presented such that Improvement Rate Difference (IRD) [13] could be calculated.
5. Published in the English language.
6. Published in a peer-reviewed journal between 2010 and 2012.

Rating Methodological Quality

The methodological quality of the studies was rated using a protocol developed by Reichow, Volkmar, and Cicchetti [14]. Separate protocols were used for studies using single subject research designs (SSRD) and those using group designs. The SSRD scale consists of six primary indicators, including participant, intervention and outcome description, baseline stability, visual analysis and experimental control. Primary indicators could receive a rating of 'high', 'adequate' or 'unacceptable'. Six secondary indicators related to inter-observer agreement, interventionist fidelity, blinding of observers, generalization/maintenance and social validity were also rated as present or absent. Improved Rate Difference (IRD) [13] was calculated for studies using SSRDs to determine the size of the effect. IRD has a long history of use in the medical literature, where it is termed "risk difference" [13].

Group designs were rated using a similar protocol which included items specific to group trials with a total of six primary indicators including description of comparison conditions and statistical data analysis and a total of eight secondary indicators including randomization and reporting of effect size. Two independent raters assessed the studies. Twenty-five percent of the studies were double coded. Interclass correlations indicate high reliability (α=.84).

Results

The systematic search of the literature produced 2498 citations. Titles and abstracts of the articles were examined. After removal of irrelevant articles, reviews, duplicates and grey literature, a total of 34 articles were included in the review. Seventeen articles used SSRD [15–18, 19•, 20, 21•, 22, 23•, 24–31] and seventeen used group designs [32, 33•, 34, 35•, 36•,

37, 38, 39••, 40••, 41••, 42, 43, 44•, 45•, 46–49], a shift from previous reviews in which there were few group designs.

Methodological Quality

Single subject research designs—Studies using SSRDs were primarily of 'weak' overall quality as assessed using the Reichow et al. [14] rating scale. Only three studies were rated 'adequate' [19•, 21•, 23•] while no studies were rated as 'strong'. Scores for each study are listed in Table 1. This overall rating is derived from the combination of 'high', 'acceptable' and 'weak' ratings received across the six primary quality indicators. Studies rated as 'weak' overall either: 1) scored 'high' on fewer than four primary indicators, 2) obtained no secondary indicators or 3) scored 'unacceptable' one or more primary indicators. Studies most frequently received a rating of 'weak' by obtaining an "unacceptable" rating for one primary quality indicator often including participant description, visual analysis and experimental control indicators.

Overall, this group of studies provided replicable descriptions of the dependent variables (17 studies), implemented manualized interventions (13), reported high inter-rater agreement (10) and examined either generalization or maintenance of treatment effects (10). Yet, these studies generally failed to thoroughly describe both participants and interventionists, include blinded raters, measure interventionist fidelity or demonstrate experimental control for each dependent variable of interest.

Group designs—Studies using group designs were of mixed quality. Scores for each study are in Table 1. Three studies obtained a rating of 'strong' achieving 'high' quality ratings on all primary indicators [39••, 40••, 41••] while five studies were considered 'adequate', achieving ratings of 'high' on four to five primary indicators and demonstrating at least two of the secondary indicators [33•, 35•, 36•, 44•, 45•]. The remaining nine studies obtained 'weak' ratings, scoring 'high' on fewer than four primary indicators or obtaining an 'unacceptable' rating for at least one primary indicator.

Altogether this group of studies demonstrated a strong link between research questions and data analysis (17 studies), implemented manualized interventions (12), provided replicable definitions of dependent variables (14), demonstrated less than 30% attrition balanced across groups (17) and implemented random assignment (14). However, the studies often failed to include adequately powered statistical analysis, describe comparison conditions with replicable precision, include blind raters, report effect sizes of at least .40 across 75% or more of the outcomes and record interventionist fidelity.

Discussion of Study Outcomes

Based on the studies reviewed, several intervention targets were addressed in the social skills interventions. These included: 1) knowledge and conceptual understandings, 2) peer relationships/friendships, and 3) joint attention/joint engagement.

Interventions to Improve Knowledge and Conceptual Understandings—Many of the interventions were aimed at improving: 1) knowledge of discrete skills such as emotion recognition or appropriate social behaviors, or 2) concepts such as theory of mind. These interventions are based on the theory that increasing knowledge of social behavior will translate into better social interactions in authentic real life situations. These types of interventions generally are carried out in groups and led by an instructor in a clinical setting with direct teaching of social skills. A number of studies also augmented these group interventions with video modeling and feedback [17, 18, 19•, 24, 27, 29, 30].

Studies in this review yielded similar results to previously published studies on knowledge, perceptions, and understandings. The outcome measures for each intervention were mostly linked to the content of the intervention. A child would, for example, be taught to recognize emotions in pictures or video, and then tested on their knowledge of emotions from a similar battery of pictures. For example, in a study aimed at teaching theory of mind (i.e., understanding others have thoughts different from oneself), children improved their conceptual theory of mind after intervention on a theory of mind test [32]. These results did not appear to generalize to other settings. In this study, similar outcomes were not observed on parent reported social behavior [32]. Similarly, Castorina and Negri [33•] found that children did better on a test of social skills after intervention (regardless of the treatment conditions: with or without siblings) but parents did not report social behavior changes. These targeted treatments typically had little effect on parents', teachers' or children's report of their own social behaviors. Social skills in natural settings as an intervention outcome rarely were observed. One exception was an RCT [38] in which video instruction of emotion recognition increased social skills observed by trained research assistants during recess or free time at school for higher functioning children (but not lower functioning children).

Summary—Overall, interventions aimed at increasing social knowledge demonstrate increased knowledge, but the effects do not appear to transfer to real life settings. Future studies may want to merge didactic knowledge modules with practice modules in authentic community settings to support the generalization of conceptual skills to natural interactions.

Interventions Addressing Peer Relationships—Traditionally, children with ASD have been prompted to initiate and respond to peers, and studies in this review continued this tradition [15, 16]. For example, for one study the outcomes of interest were prompted initiations, responses and sharing between peers [16]. Maintenance and generalization data were not collected but one might not expect skills to maintain in the absence of an adult to prompt behaviors, and one might question an outcome that is prompted and not spontaneous. In several other studies, researchers focused on the context for teaching children to initiate and respond to peers. Three studies used play dates and club activities to teach children with ASD to initiate and respond to peers, and to develop friendships [21•, 22, 23•]. Two of these three studies [21•, 23•] recorded spontaneous interactions [21•] or initiations [23•] rather than prompted initiations. Differentiation of spontaneous versus prompted social initiations is a conceptual improvement that provides evidence toward children's ability to generate social behaviors on their own initiative rather than responding to prompting by an adult. While these studies suggest some success of this teaching approach on child outcomes, an important advancement during this review period was the number of RCTs incorporating the same elements as in the SSRDs (teaching of peer initiations/responses using the context of play dates).

Three RCTs using a wait-list design based on the same model of parent-mediated social skills intervention [50] demonstrated positive outcomes for children and adolescents [36•, 37, 44•]. Studies delivered weekly group based social skills intervention for 14 weeks focusing on social information "critical social situations" including establishing social networks with peers, entering and negotiating social interactions, and engaging in peer play and social "get togethers" in community settings [35•]. In all three studies parents reported more "get togethers" with friends and better social skills post intervention. In two of the studies, participants also reported less loneliness [36•, 37]. A limitation of these findings, however, is that the main outcomes were based on parent report and parents were involved in the intervention; thus as informants they are not unbiased. While parents reported more hosted get-togethers, only one study reported increased numbers of get togethers in which the child was a guest [37]. Generalization to natural settings was not reported; however, Frankel et al. [36•] reported that in a subsample of children, those who engaged in more hosted play dates were

also more engaged on school playgrounds. This finding suggests that increasing experiences with peers through facilitated play dates may have benefits in the school context.

Another RCT was conducted in the school setting representing a departure from the other studies during this review, which were carried out in clinic settings [41••]. This study randomized children with ASD who were high functioning and in general education classrooms to combinations of two different interventions designed to improve peer interactions. One intervention focused on teaching social skills to the child with ASD directly. This intervention addressed the top three challenges the child demonstrated on the playground at school. The other intervention focused on teaching three typical peers in the child with ASD's classroom on how to engage any child having a social challenge on the playground. Sixty children with ASD were randomized to receive one of the interventions, to receive both of the interventions, or to receive neither of the interventions. The intervention was 12 sessions, carried out at school, with the primary outcome measure based on the number of peer connections from a peer social network measure. Results indicated that children with ASD who received an intervention involving classroom peers received more friend nominations, were more connected to social groups at school, and were less isolated on the playground. Their teachers also reported improved classroom social skills. Thus, this intervention has potential for improving social engagement at school; however, the intervention was implemented by researchers on the school campus and not transferred to school staff. Sustainability is less likely without transfer of the implementation of an intervention to the school personnel, and these types of community trials should be the focus of future research.

Summary—Previously identified gaps [12] were addressed by studies of adequate quality included in this review. Tests of parent-mediated interventions for adolescents resulted in increases in social skills knowledge and interactions between teens [44•], siblings were included (although no significant effects were attributed to their presence) [33•, 34] and some studies included cognitively delayed individuals [38]. Greater numbers of RCTs were reported during this review period, some with reasonably large sample sizes (>50), and rigorous designs (RCTs) and one was also implemented in an authentic community setting.

Interventions Addressing Joint Attention/Joint Engagement in Young Children

—A number of interventions directly addressed core social deficits in young children, namely the development of joint attention/joint engagement between the child and an adult (parent or teacher). Joint attention skills refer to gestures used to share an experience with another person, including coordinated looking as well as showing, pointing and giving objects to share. Joint engagement refers to the amount of time dyads are engaged together in shared activities. Both joint attention skills and joint engagement are impaired in young children with ASD. Two advancements are noted for this review. First, most studies focusing on joint attention/joint engagement used RCTs in which an experimental intervention was compared to practice as usual. Only one SSRD study was reported, a change from previous reviews in which most studies examining joint attention used SSRDs. Another advancement is that the majority of studies included effectiveness trials focused on teacher delivery of intervention in natural settings, a dramatic departure from earlier clinic-based studies.

Preschoolers—Three effectiveness studies [20, 39••, 46] tested adaptations of a joint attention and play intervention that had previously shown clinic-based efficacy [51, 52]. Dykstra et al [20] implemented a SSRD while both Kaale et al. [39••] and Lawton and Kasari [46] carried out RCTs in which teachers in specialized and non-specialized preschool settings implemented the intervention. All three studies demonstrated effects on social behavior with some variation that should inform future studies. For example, Dykstra et al [20] compared group instruction versus group plus 1:1 instruction for three participants using a multiple baseline design. While children appeared to benefit from the combined group and 1:1

interventions, this study is limited in two notable ways. First, joint attention skills were combined with social interaction and requesting skills, and functional and symbolic play acts were combined in the data analysis. Given that children with ASD have specific impairments in joint attention skills (more so than requesting skills) this study does not provide specific information on which skills improved. The same is true for functional and symbolic play skills. The combination of these two types of play skills into one play category does not inform whether the difficult-to-change domain of symbolic play skills actually changed or if the results were driven by functional play acts. Second, the conclusions one can make based on the small sample are limited. Although children appeared to benefit from group plus 1:1 instruction, the question remains whether receiving 1:1 instruction prior to group may have led to different conclusions. In this study group instruction was delivered first and then paired with 1:1. Due to the lack of variation in the order of treatment, it is not clear whether the reverse (1:1 followed by group intervention) would have equal or potentially greater effects.

The two RCTs examining a similar intervention model provide greater information on skills that could be changed in a brief and targeted teacher-mediated intervention. Both studies implemented a developmentally informed behavioral intervention that specifically focused on the teaching of joint attention and play skills to preschool aged children with ASD in the classroom. One study received a rating of strong quality [39••], and the other weak (primarily due to lack of participant description; Lawton and Kasari [46]) although both yielded significant findings. Kaale et al. [39••] yielded significant effects on children's initiations of joint attention in the classroom, and joint engagement with parents suggesting generalization from classroom instruction to parents who were not involved in the intervention. Similarly, Lawton and Kasari [46] also found significant effects for children's initiations of joint attention in the classroom. Given that spontaneous initiations are particularly difficult to teach, both of these studies are highly significant given they were mediated in real world settings by community staff. These studies are a significant advancement from clinic based trials, single subject designs, and interventions that focused more on requesting skills than joint attention initiations.

Toddlers—Two additional studies tested intervention effects on toddlers. One intervention was mediated through interventionists and the other through parents, both in university, clinic settings. While the interventionist-delivered treatment did not show effects on joint attention skills, it did result in differences in toddler's imitation skills [43]. Similarly the parent-mediated intervention did not result in changes in child joint attention initiations but did show effects on joint attention responses and improved joint engagement [40••]. Children decreased their focus on objects only and increased their joint engagement with their parent and objects. Increasing engagement between parent and child may be especially important to the development of social and communication skills. Given the better outcomes on joint attention initiations for preschool aged children, these studies on toddlers highlight potentially critical developmental differences in intervention effects. It may be that younger children are not quite ready for developing joint attention initiations or may require greater density of intervention, or different sequencing of interventions. The results also suggest that treatment delivery may be an important consideration with parent-mediated interventions reporting more changes on core deficits than group delivery by trained interventionists.

Summary—Altogether, interventions addressing joint attention/joint engagement appear to facilitate significant improvements in skills that are core developmental challenges for children with ASD. Future studies should further explore pairing different treatment deliveries (e.g., parent and therapist, or group and individual instruction) for maximum benefit. At this juncture, joint attention interventions demonstrate both efficacy and effectiveness, and are primed for further deployment into community settings.

Conclusions

The last two years of intervention research on social skills have produced important advancements. One is the greater focus on core deficits, including joint attention, joint engagement, social initiations and responses, and development of friendships. Other advancements included the increased number of group designs with many employing randomized controlled trials and the expansion of topics, including studies addressing adolescents, parent-mediated approaches, sibling involvement, and interventions conducted in real world settings. While impressive in the range of topics addressed, future research still needs to tackle four specific areas. First, we need study designs that can address the active ingredients of interventions (e.g., dose required to get effect, agent of change, such as parent, peer, teacher or sibling). We need to move beyond testing an intervention against practice as usual, and compare interventions that differ on critical elements.

A second issue is our understanding of meaningful and sustainable outcomes. Outcome measures remain limited. There is an over-reliance on potentially biased informants (i.e., involved in the intervention or unblinded), outcomes that result from teaching to the test or the result of prompting rather than spontaneous initiations. Outcomes need to provide confidence that meaningful change has occurred (improved social relationships, sustained social interactions).

Third, while we used a rating system to identify quality indicators of studies, this system yielded weak ratings for most studies. Several studies received a weak rating due to limited description of participants while otherwise receiving high quality ratings for key study elements considered important to an intervention trial including data analytic procedures, intervention/outcome description, fidelity and treatment integrity. Moreover, although a study received a strong quality rating, participants may not have achieved significant sustainable benefit from the intervention. Thus, having a means to evaluate the quality of intervention research is a significant advancement and future efforts should further consider whether the intervention merits adoption.

Finally, we continue to focus on select samples of children, often high functioning, and middle class who have the resources to participate in a study at a clinic. The vast majority of children with ASD are not represented in research—children with co-morbidities, non-English speaking children, minimally verbal children, and ethnically and culturally diverse samples. Future studies should include underserved and underrepresented populations of children with ASD thus broadening our understanding of intervention effectiveness for children with ASD.

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Table 1

Participant information, outcomes and methodological quality

Study	Participants	Intervention	Measures	Outcomes (overall IRD or effect size)	Primary (P) and secondary (S) quality indicators & overall rating
Single subject research designs					
Banda & Hart [15], 2010 (USA)	N=2; School age; female	Peer Training	Frequency Count	Initiations to Peer **(small)** Responses (**small**) Sharing Behavior **(small)**	P- 4/6 S- 2/6 Weak
Banda et al. [16], 2010 (USA)	N=2; School age; male	Peer Training	Frequency Count	Initiations to Peer **(large)** Responses to Peer **(large)**	P- 4/6 S- 2/6 Weak
Buggey [17], 2012 (USA)	N=3; Preschool; male	Video Modeling	Frequency Count	Initiations in stage 1 **(no effect)** Initiations in stage 2 **(no effect)**	P- 2/6 S- 2/6 Weak
Buggey et al. [18], 2011 (USA)	N=4; Preschool; male (2), female (2)	Video Modeling	Frequency Count	Initiations **(moderate);** Maintenance **(small)**	P- 4/6 S- 3/6 Weak
Charlop et al. [19•], 2010 (USA)	N=3, School age; male	Video Modeling	Percent of Opportunities	Verbalization **(large);** Gen **(large)** Intonation **(large);** Gen **(large)** Gesture **(large);** Gen **(large)** Facial Expression **(moderate);** Gen **(large)**	P- 4/6 S- 3/6 Adequate
Dykstra et al. [20], 2012 (USA)	N=3; Preschool; male (1), female (2)	Advancing Social Communication and Play (ASAP)	Intervals with behavior present	Social interaction (SI), requests (BR) and joint attention (JA) in group only instruction: **group (small), individual (moderate)** SI, BR & JA in full instruction: **group (small), individual (large)** Play in group only instruction: **group (moderate), individual (moderate)** Play in full instruction: **group (small), individual (large)**	P- 2/6 S- 1/6 Weak
Jull & Mirenda [21•], 2011 (Canada)	N=4; Preschool (2); male	Parent Facilitated Play Dates	Intervals with behavior present	Parents' correct strategy use: **large** Intervals with peer interaction: **large**	P- 5/6 S- 2/6 Adequate
L. Koegel et al. [22], 2012 (USA)	N=3; Preschool; male	Facilitated Social Play with Initiations Training	Intervals with behavior present; event recording of initiations; ratings of affect	<u>Intervention without initiations:</u> Social behavior **(large);** Gen **(small)** Initiations **(small);** Gen **(no effect)** Affect **(large);** Gen **(small)** <u>Intervention with initiations:</u> Social behavior:**(large);** Gen **(large)** Initiations **(large);** Gen **(large)** Affect **(large);** Gen **(large)**	P- 1/6 S- 4/6 Weak
R. Koegel et	N=3; School age; male	Clubs Based on Perseverative Interests	Intervals with behavior present; Frequency	Engaged with peers: **(large)**	P- 4/6 S- 2/6 Adequate

Study	Participants	Intervention	Measures	Outcomes (overall IRD or effect size)	Primary (P) and secondary (S) quality indicators & overall rating
al. [23•], 2012 (USA)				Initiations **(large)**	
Marzullo-Kerth et al. [24], 2011 (USA)	N=4; School age; male	Video Modeling	Intervals with behavior present	Sharing during training **(large);** Maintenance **(large)** Sharing generalization **(large)**; Maintenance **(large)** Nonsharing trials **(no effect);** Maintenance **(no effect)**	P-3/6 S-1/6 Weak
Parker & Kamps [25], 2011 (USA)	N=2; School age; male (1), female (1)	Social Scripts and Task Analysis	Intervals with behavior present; Completed steps	Completed task analysis steps **(large)** Peer directed verbalizations **(moderate)**	P- 1/6 S- 1/6 Weak
Reichow & Sabornie [26], 2009 (USA)	N=1; School age; male	Social Stories (SS) and Cue Fading (CF)	Frequency	Verbal greeting with SS **(large)** Verbal greeting with CF **(large)** Verbal greeting to peer with SS **(large)** Verbal greeting to peer with CF **(large)** Effect CF over SS for all greetings **(small)**	P- 5/6 S- 1/6 Weak
Robinson [27], 2011 (USA)	N=4; Preschool (1), School age (3); male	Modeling and Video Feedback by Paraprofessionals	Percentage correct, Frequency, Likert rating	Paraprofessional fidelity **(large);** Gen **(large);** Main **(large)** Social communication **(large);** Gen **(large);** Main **(large)** Affect **(small);** Gen **(small);** Main **(small)**	P- 2/6 S- 4/6 Weak
Schneider & Goldstein [28], 2010 (USA)	N=3; School age; male	Social Stories (SS, n=4) and Visual Schedules (VS, n=1)	Percentage of interval with behavior present	On task behavior with SS **(small)** On task behavior with VS **(large)** On task VS over SS **(moderate)**	P- 2/6 S- 3/6 Weak
State & Kern [29], 2012 (USA)	N=1; School age; male	Video Feedback and Self-Monitoring	Percentage of interval with behavior present	Inappropriate noises-teacher **(small);** peers **(moderate)** Inappropriate interactions-teacher **(no effect);** peers **(no effect)** Appropriate interactions-teacher **(small);** peers **(no effect)**	P- 3/6 S- 2/6 Weak
Tetreault & Lerman [30], 2010 (USA)	N=3; Preschool (1), School age (2); male (2), female (1)	Video Modeling + Edible Reinforcers and Prompting	Frequency	Correct exchanges **(moderate)** Generalization of correct exchanges **(small)** Correct eye contact **(moderate)** Correct scripted responses **(moderate)**	P- 2/6 S- 1/6 Weak
Wichnick et al. [31], 2010 (USA)	N=3; Preschool (1), School age (2); male (2), female (1)	Script Fading	Percentage of interval with behavior present	Unscripted initiations **(large)** Scripted initiations **(large)** Generalized initiations **(moderate)**	P- 2/6 S- 1/6 Weak
Group design studies					
Begeer et al. [32], 2011 (Netherlands)	N=36; School age male (33), female (3)	Theory of Mind (ToM) Training-Treatment vs. Waitlist Delayed Intervention	ToM Test; Index of Empathy; CSBQ; LEAS-C	Treatment group showed significantly greater increases on ToM test than control (*d*=.75), primarily first order ToM (*d*=1.00). No effect on second order ToM, emotion recognition, imitation or self reported empathy. No differential treatment effect on emotional awareness.	P- 3/6 S- 4/8 Weak

Study	Participants	Intervention	Measures	Outcomes (overall IRD or effect size)	Primary (P) and secondary (S) quality indicators & overall rating
Castorina & Negri [33•], 2011 (Australia)	N=21; School age, male	Social Skills Training- Sibling vs. No Sibling vs. Control Group	CASP; SSRS	Children in program had significant higher CASP scores at exit (ηp^2= .59) and follow up (ηp^2= .59). No difference between groups in parent reported social skills.	P- 4/6 S- 3/8 Adequate
Chu & Pan [34], 2012 (Taiwan)	N=42 (21 ASD, 21 TD); School age; ASD-male (20), female (1), TD- male (6), female (15)	Peer and Sibling Assisted Swim Program vs. Swim Control Group	HAAR Aquatic Skills Checklist; Observations of Social Interaction and Participation	Increase in social interaction behavior as well as instances of physical participation in the activity in sibling and peer conditions than control. All children improved their aquatic skills.	P- 2/6 S- 3/8 Weak
DeRosier et al. [35•], 2011 (USA)	N=55; School age; male (53), female (2)	SS.GRIN-HFA Treatment versus SS.GRIN control	Achieved Learning (ALQ); SRS; Social Self Efficacy; Social Dissatisfaction	Statistically significant differential effects in parent reported social skills (SRS- range in ES *d*=.67 to.94; ALQ *d*=.75) and social self efficacy (*d*=.51) in favor of the treatment group. No significant effect of treatment on children's reported social self efficacy or social dissatisfaction.	P- 5/6 S- 4/8 Adequate
Frankel et al. [36•], 2010 (USA)	N=68; School age; male (58), female (10)	Children's Friendship Training (CFT) vs. Delayed Intervention	ASSQ; Loneliness Scale; Piers-Harris Self Concept Scale; QPQ; SSRS; PEI-Teacher	Children in CFT reported significantly being less lonely and more popular, results were not maintained at follow up. Parents reported increased in number of play dates and via the SSRS reported increased in self-control and assertion as well as lower internalizing and externalizing behavior scores, all maintained at follow up. No effects were reported by teachers.	P- 4/6 S- 3/8 Adequate
Gantman et al. [37], 2012 (USA)	N=17; Adolescents, male (12), female (5)	UCLA Peers vs. Delayed Treatment	SRS; SSRS; SELSA; Empathy Quotient; SSI; Quality of Socialization; Test of Young Adult Social Skills Knowledge	Treatment group showed significant gains over control in adolescents' self reported social emotional loneliness, knowledge of social skills, empathizing and social responsiveness as well as increases in cooperation and assertion (SSRS). Caregiver reported frequency of "get togethers" also increased.	P- 3/6 S- 2/8 Weak
Hopkins et al. [38], 2011 (USA)	N=49; School age; male (44), female (5)	Face Say vs. Control "Tux Paint" Computer	Emotion and Facial Recognition; SSRS; Social Skills Observation (SSO)	Significant increase over control group in emotion recognition using photos for both low functioning (LFA) and high functioning (HFA) groups as well as with drawings for HFA group. Increases in facial recognition for children with HFA. Treatment group showed increases in SSRS scores (LFA-*d*=1.01, HFA-*d*=.29) and SSO (LFA-*d*=.81, HFA-*d*=1.34).	P- 3/6 S- 3/8 Weak
Kaale et al. [39••], 2012 (Norway)	N=61; Preschool; male (48), female (13)	Joint Attention Intervention vs. Treatment as usual	ESCS; Observed Duration of Joint Engagement & Joint Attention Skills	Significant increase in frequency of JA skills in teacher-child interaction (*d*=.44), no effect on joint engagement, but significant increase in joint engagement during parent-child interaction (*d*=.67). No significant increases in JA skills during standardized assessment (ESCS).	P- 6/6 S- 4/8 Strong

Study	Participants	Intervention	Measures	Outcomes (overall IRD or effect size)	Primary (P) and secondary (S) quality indicators & overall rating
Kasari et al. [40••], 2010 (USA)	N=38; Toddlers; male (29), female (9)	JASPER vs. Delayed Intervention	Observed Joint Engagement, Play Types, Joint Attention Skills; Caregiver Quality of Involvement	Immediate treatment group showed significant increases in time jointly engaged (*d*=.97), decreases in object only engagement (*d*=1.09), responsiveness to joint attention (*d*=.74), types of functional play (*d*=.88) compared to waitlist. Initiations of joint attention and diversity of symbolic play did not differ.	P- 6/6 S- 6/8 Strong
Kasari et al. [41••], 2012 (USA)	N=60; School age; male (54), female (6)	Child Assisted, Peer Assisted, Child Plus Peer, vs. Control	Social Network Salience (SNS); Playground Observation; Teacher Perception-Social Skills	Child and Peer group showed greatest increases in SNS over child (*d*=1.12), peer (*d*=.69) and control (*d*=1.18), maintained over child (*d*=.97) at follow up. Solitary engagement significantly decreased for children in Peer at follow up (*d*=0.94) and joint engagement increased (*d*=.77). Students in Peer also received increased friendship nominations (*d*=.74) post intervention. Teachers reported significant change in Peer students' social skills post intervention (*d*=.44).	P- 6/6 S- 6/8 Strong
Koenig et al. [42], 2010 (USA)	N=44; School age; male (34), female (10)	Group Social Skills Intervention vs. Waitlist	CGI- Improvement; SCI	CGI scores were significantly greater for the treatment group over waitlist. No significant gains were made on the SCI.	P- 4/6 S- 3/8 Weak
Landa et al. [43], 2011 (USA)	N=48; Toddlers; male (40), female (8)	Interpersonal Synchrony vs. Non-Interpersonal Synchrony	CSBS; Observed Socially Engaged Imitation; MSEL Expressive Language (EL) and Visual Reception (VR)	Treatment group showed significantly higher rate of change in socially engaged imitation (SEI: *d*=.48) pre to post and greater total SEI at follow up only (*d*=.86). No effect on MSEL EL or VR. No effect on initiations of joint attention or shared positive affect.	P- 3/6 S- 3/8 Weak
Laugeson et al. [44•], 2012 (USA)	N=28; School age and adolescents; male (23), female (5)	UCLA Peers vs. Delayed Intervention	SSRS; SRS; QPQ; TASSK-R	Parents of students in the treatment group reported greater social skills, reduction in ASD symptoms (SRS) and increase in "get togethers" over delayed treatment. Significant increase in knowledge of social skills was reported (TASSK-R) after treatment and via teacher report at follow up only.	P- 4/6 S- 2/8 Adequate
Lawton & Kasari [45•], 2012a (USA)	N=52; Preschoolers; male (40), female (12)	Joint Attention (JA) vs. Symbolic Play (SP) vs. Control	ESCS	Increases in joint attention with shared positive affect as well as joint attention with shared positive affect and an utterance were found 6 month and 12 month follow up for both JA and SP conditions while no effect was found for control participants.	P- 5/6 S- 5/8 Adequate
Lawton & Kasari [46], 2012b (USA)	N=17; Preschoolers; Gender not reported	JASPER vs. Delayed Intervention	ESCS; Classroom Observations	Children showed significant increases in initiations of joint attention (*d*=1.85) during classroom observation including significant increases in points (*d*=2.02) and shows (*d*=1.85) to share. Only increases in shows were found during structured assessment (*d*=2.02). Large effects were also found for decreases in object engagement (*d*=1.41) and increases in supported joint engagement (*d*= 1.24)	P- 3/6 S- 6/8 Weak

Study	Participants	Intervention	Measures	Outcomes (overall IRD or effect size)	Primary (P) and secondary (S) quality indicators & overall rating
Lerner et al. [47], 2010 (USA)	N=17; School age & adolescents; male (14), female (3)	SDARI Intervention vs. Control	CBCL; SSRS; SRS; Emory Dyssemia Index; DANVA-2; BDI-Y	Overall participants displaced decreases in EDI and CBCL scores. No effects found via SSRS. Treatment group showed greater decrease in errors in identifying emotions and decrease on CBCL social problems.	P- 2/6 S- 1/8 Weak
Wong & Kwan [48] 2010 (China)	N=17; Toddlers; male (16), female (1)	Autism 1-2-3 vs. no intervention (crossover trial)	ADOS; RFRLRS; SPT; PSI	No between group differences in ADOS subscale scores, symbolic play, parent stress or parent observations of language or social behavior. Combined treatment groups showed decreases in ADOS reciprocal social interaction subscale score, symbolic play, parent report of language and social behavior as well as total parent stress score.	P- 1/6 S- 2/8 Weak
Young & Posselt [49], 2012 (Australia)	N=25; Preschoolers & School age; gender not reported	Transporters vs. Control Television Show	NEPSY-II (affect recognition); Face Task; SCQ	Participants in the Transporters group experienced significantly greater increases in affect recognition than control participants (ηp^2= .53). The Transporters group also experienced a large gain in emotion recognition (NEPSY: *d*=1.7, Face Task: *d*=.92). No differential effect was found on social peer interest, gaze aversion or eye contact.	P- 1/6 S- 2/8 Weak