

Making the connection: randomized controlled trial of social skills at school for children with autism spectrum disorders

Connie Kasari,¹ Erin Rotheram-Fuller,² Jill Locke,³ and Amanda Gulsrud¹

¹Center for Autism Research and Treatment, Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, CA; ²College of Education, Temple University, Philadelphia, PA; ³Center for Mental Health Policy and Services Research, University of Pennsylvania, Philadelphia, PA, USA

Background: This study compared two interventions for improving the social skills of high functioning children with autism spectrum disorders in general education classrooms. One intervention involved a peer-mediated approach (PEER) and the other involved a child-assisted approach (CHILD). **Method:** The two interventions were crossed in a 2 × 2 factorial design yielding control, PEER, CHILD, and both PEER and CHILD conditions. Sixty children participated from 56 classrooms in 30 schools. Interventions involved 12 sessions over 6 weeks, with a 3-month follow-up. Outcome measures included self, peer and teacher reports of social skills and independent weekly observations of children on their school playground over the course of the intervention. **Results:** Significant improvements were found in social network salience, number of friendship nominations, teacher report of social skills in the classroom, and decreased isolation on the playground for children who received PEER interventions. Changes obtained at the end of the treatment persisted to the 3-month follow-up. **Conclusions:** These data suggest that significant improvements can be made in peer social connections for children with autism spectrum disorders in general education classrooms with a brief intervention, and that these gains persist over time. **Keywords:** Social skills, autism spectrum disorders, peer relationships, sociometrics, school.

Introduction

Peer relationships are critically important to children's success at school. Many studies describe the benefits of healthy social development on children's emotional, social and academic performance at school (Ladd, 1990; McClelland, Morrison, & Holmes, 2000; Oden & Asher, 1977). Despite the importance of social relationships at school, some children may be particularly prone to feeling isolated and having few peer relationships, as is commonly noted about children with autism spectrum disorders (ASD).

Interventions are needed to build peer interaction skills of children with ASD, and generally fall into two categories. Direct training is the most common of the two, in which social skills training is provided directly to the child with autism, either in groups or individual contexts (Bellini, Peters, Benner, & Hope, 2007; Rao, Beidel, & Murray, 2008; Williams White, Keonig, & Scahill, 2007). The active ingredient is direct instruction of the child's social skills (e.g. social etiquette or how to take turns in conversation). Peer-mediated models, on the other hand, focus intervention on the peers of the child with ASD (Bellini et al., 2007; Rao et al., 2008). In peer-mediated models, the active ingredient is indirect, by training peers how to engage the child with ASD. Both approaches have theoretical and empirical

support, but both are missing important evidence of efficacy. For example, direct training approaches tend to occur outside of natural contexts. Variants on this intervention model have sometimes shown promising outcomes, but generalization to school and community settings has been poor or unmeasured (Bellini et al., 2007; Rao et al., 2008; Williams White et al., 2007). On the other hand, peer-mediated models have shown good outcomes and generalization for preschool children, but have not been rigorously tested among school-aged children (McConnell, 2002). There has not yet been a controlled study comparing the efficacy or maintenance of these two types of socialization interventions. It is highly likely that children who receive both models will perform better than children who receive only a single model. The two interventions may work synergistically leading to an effect greater than the sum of their parts. Thus, by developing children's social skills they can take advantage of peer willingness to engage. All interventions are expected to be superior to inclusion alone.

The objective of this randomized controlled trial was to compare the efficacy of school-based social skills interventions to improve the social salience and peer engagement of high functioning, fully included children with autism. Our secondary goals were to examine the effect of interventions on friendship nominations, friendship reciprocity and teacher report of social skills.

Conflict of interest statement: No conflicts declared.

Method

Experimental design

This study was designed as a test of the efficacy of two commonly applied social skills interventions: child-assisted (CHILD) and peer-mediated (PEER). A classic 2×2 factorial design was used with two factors, CHILD and PEER, with the four cells being (a) inclusion (control) condition, (b) child-assisted intervention, (c) peer-mediated intervention, and (d) both child and peer interventions.

Participants

A total of 243 children were prescreened by telephone for participation in the study, and 83 families signed consent from August 2003 to September 2007. Children were included in the study if they met criteria for ASD on the ADI-R and ADOS administered by blind, independent psychologists, were fully included in a regular education classroom for at least 80% of the school day, were between the ages of 6–11 years old, in Grades 1–5, had an IQ of 65 or higher (independently assessed using the WISC-IV), and did not have additional diagnoses. Of the 83 children with ASD who signed consent, 23 did not get randomized to a treatment condition (nine schools refused our participation; six parents withdrew before randomization; 6 children did not meet the IQ criteria; 2 children did not meet criteria for ASD; see Figure 1).

Participants included 60 target children with ASD and 815 typically developing children from the target children's classroom. Participants were recruited from 56 classrooms in 30 different schools across the greater Los Angeles area. Of the children with ASD, 15 were in first grade, 18 in second grade, 8 in third grade, 11 in fourth grade and 8 in fifth grade. Ethnic backgrounds included 46.6% Caucasian, 5% African American, 21.7% Latino, 16.7% Asian, and 10% Other and 90% were male. All were fully included in regular education classrooms for 80% or more of the school day and were an average of 8.14 years old ($SD = 1.56$), with an average IQ of 90.97 ($SD = 16.33$).

Interventionists and treatment integrity. Seven graduate students in Educational Psychology provided interventions; all had experience with ASD and received training to deliver the interventions at fidelity prior to actual cases. Interventionists had regular weekly supervision from the PI and study coordinator, and the coordinator observed randomly selected sessions of both conditions for quality of treatment adherence. Twenty percent of therapist treatment notes were randomly selected and double coded for adherence to the treatment protocol. Interventionist fidelity to treatment elements was rated at 94% accuracy to the treatment manual (agreement of 100% between two independent raters). No significant differences were found in treatment effects across interventionists.

Randomization and study procedures

All intervention sessions took place at the school of the child with ASD. Treatment protocols were developed and manualized for this study. The design of the study is a 2×2 factorial, with children randomized to two levels of treatment: (a) peer-mediated intervention (or no peer-mediated intervention) and (b) child-mediated intervention (or no child-mediated intervention). The design resulted in 30 children receiving a PEER intervention and 30 children receiving a CHILD intervention. Subsumed within these levels of treatment, were 15 children receiving both PEER and CHILD treatments, and 15 children receiving neither treatment (inclusion only). After the acute phase, all inclusion only children were rerandomized to one of the active treatment conditions. This factorial design permitted a test of the main effects of both treatments as well as a test of their interaction, while maximizing statistical power.

Children with ASD were block randomized by class, and stratified on grade, so that in the case of multiple target children per class, there was no bleeding of treatment effects. The vast majority of classes had only a single child with autism in the class (52 of 56 classrooms); because only four classes had more than one child with autism (and these classes were randomly

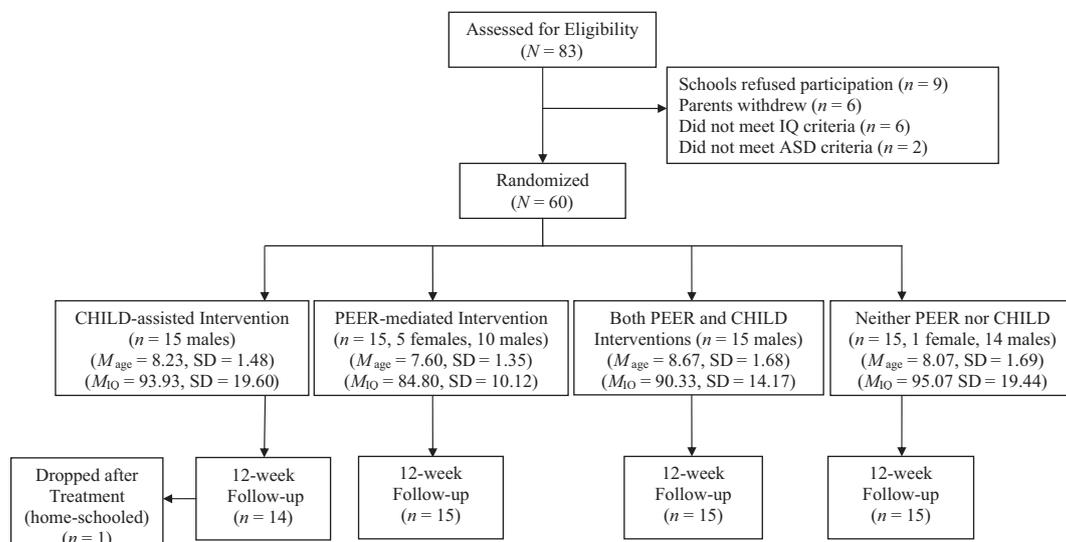


Figure 1 CONSORT chart: enrollment and study design

distributed across conditions) we analyzed the data at the child level rather than the class.

Treatments

Different interventionists conducted the CHILD and the PEER interventions, and the interventions were also delivered separately.

Child-assisted (CHILD) intervention. Children with ASD met with a trained interventionist during recess or lunchtime for 20 min twice weekly for 6 weeks. The goal of CHILD was to help children with ASD, through direct instruction, to develop strategies to engage socially with their peers. The intervention began by assessing the target child's social strengths and weaknesses using playground observations, teacher and parent report. The interventionist and coordinator used these assessments to determine the social skill to target (e.g. child needed to learn to play specific games on the playground, or needed to learn how to enter into a game or conversation with a peer). Didactic instruction, role playing, and practice with the interventionist were used to target each deficit. Skills were targeted one at a time, with continued practice to improve the targeted behavior. Once the first skill was mastered, a second was introduced. Typical peers were not trained. Due to the heterogeneity in symptom presentation targeted skills were individualized to each child using a developmental approach. Some children in our intervention had difficulty entering and sustaining attention in games or maintaining a conversation, whereas other children needed specific skill building in the fundamentals of playing a particular game on the playground and flexibility training surrounding the rules of the game. For example, if entering and playing handball

was a targeted skill, we broke down the steps of handball and taught the child each component of the game using modeling and direct instruction (i.e. understanding the rules, entering the game gracefully, waiting in line, cheering on peers, positioning the hands, hitting the ball, running back to a good position on the court, showing good sportsmanship, returning to the line when out).

Peer-mediated (PEER) intervention. Three typically developing children from the target child's classroom were taught strategies for engaging children with social challenges on the playground. Study staff and teachers selected peer models based upon their social network salience (SNS) within the class, and teacher opinion of appropriateness. The peers met in a group format with a trained interventionist for 20 min twice weekly during recess or lunchtime. The goal of PEER was to increase appropriate, meaningful social interaction for children with ASD by teaching typical peers to interact with children who had difficulty making friends. For example, peers were taught how to identify isolated children (e.g. those standing on the side of the yard instead of participating in a game), and given strategies to engage them (e.g. ask them to play in an ongoing game on the playground). Peers were taught to lend social support via direct instruction, modeling, role playing, and rehearsal to any children in their class that might have social difficulties. Topics for group discussion included identifying appropriate and inappropriate behaviors on the playground, strategies for encouraging positive social interactions, initiating play interactions, facilitating engagement in games and strategies for conflict resolution. The target child with ASD was never directly identified, in order to maintain the child's confidentiality (see Table 1).

Table 1 Intervention description

	CHILD (6 weeks total)	PEER (6 weeks total)
Children trained	Target child with ASD	Three classroom peers of child with ASD (determined by teacher recommendation and average social network salience (SNS))
Needs assessment	Up to four individualized skill deficits identified using observations and child assessments	None
Training format	1:1 didactics and practice with adult interventionist during unstructured social periods of school day	Group peer training during unstructured social periods of school day
Intensity/duration	6 weeks total: 12 sessions of 20 min each, 2x per week	6 weeks total: 12 sessions of 20 min each, 2x per week
Skill building	Individual, personalized skill building sessions with the child with ASD that targets each skill sequentially (behavioral and developmental approaches). Each targeted skill was reviewed with the child, with multiple opportunities for practice during sessions and adult coaching, modeling and feedback	Group social skills training was focused on positive social modeling. Peers were given the opportunity to practice facilitating and engaging children with social needs on the playground. Specific social concerns of the child with ASD were addressed globally so as not to identify the child with ASD directly
Homework	Homework was used to encourage children with ASD to practice strategies and skills in social interactions without the interventionist present	Homework was used to encourage peers to practice strategies and skills to engage with children with social needs
Reinforcement	Child was reinforced for social attempts and successes with peers	Peers were reinforced for appropriate engagement with children with social needs

CHILD, child-assisted approach; PEER, peer-mediated approach; ASD, autism spectrum disorders.

Measures

Social Network Survey. The Social Network Survey yielded the primary outcome measure of SNS as well as secondary outcome measures of friendship reciprocity, indegrees, outdegrees and rejections (see below).

Children were asked to identify who they like to hang out with and who they do not like to hang out with in their classroom. From this list, they were instructed to star their best friend, and circle their top three friends. They were also asked, 'Are there kids in your class who like to hang out together? Who are they?' Children then listed the names of all children within the class who liked to hang around together in groups. A minimum of 50% of children in each classroom completed the study measures to ensure reliability of collected data (Cairns & Cairns, 1994). Most children were able to complete the survey independently and privately; however, researchers interviewed younger, nonreading children individually.

Primary outcome: SNS. Social network salience refers to a ratio score indicating the prominence of a child within his classroom social network. Traditional social network classifications (Cairns & Cairns, 1994) were designed to be cross-sectional measures of children's classroom SNS at one time point. In the current study, two related scores were calculated in order to determine a student's level of involvement in the classroom's social networks: (a) the student's 'individual centrality' was the total number of nominations to a peer group within the classroom, and (b) SNS ratios at baseline, exit, and follow-up using children's raw individual centrality divided by the highest raw individual centrality score of the entire classroom at baseline to examine the *change* of children's SNS as a result of the intervention. The range of individual centrality scores varied depending on the total number of nominations in the classroom, and thus were normalized using the ratio SNS score. SNS scores were used instead of change scores since they were normalized on the most nominated student in the classroom at baseline to standardize children's social salience within the classroom over time. The benefit of using ratio scores allows us to capture children's social salience within the classroom on a continuous scale.

Primary outcome measure: playground observation of peer engagement. Developed for this study, the playground observation of peer engagement (Kasari, Rotheram-Fuller, & Locke, 2005; Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011) is a timed interval behavior coding system. Independent, blinded observers watched the target child on the playground for 40 consecutive seconds and then coded for 20 s during the recess or lunch play period (an average of 15 min per observation). Observers were trained and considered reliable with a criterion $\alpha > .80$; reliability collected on 20% of sessions during the study was consistently above .80.

Playground engagement states were expressed as the percentage of intervals the target child spent in solitary play (i.e. unengaged with others) and jointly engaged

with others (i.e. turn-taking in games with rules and engagement in conversations or joint activities).

Secondary outcome measures from Social Network Survey. *Indegrees* were coded as the total number of *received* friendship nominations, whereas *outdegrees* were the total number of *outward* friendship nominations by the child. *Rejects* were the total number of times each child was identified as someone other students 'did not like to hang out with'. Children were considered to have *reciprocal friendships* if they selected each other as their top three or best friends within the classroom (measured as a percentage from 0 to 100).

Secondary outcome measure: teacher perception of social skills. The teacher perception of social skill (TPSS) is a 26-item questionnaire that uses a 3-point Likert scale to rate 12 items regarding teachers' perceptions of participants' social skills (1 = *never*, 2 = *sometimes* and 3 = *very often*). The social skills domain describes the child's strengths, such as adaptability to the school classroom and environment, quality of interactions with peers, and popularity or likeability among peers. The Early Head Start FACES program adapted the measure and reported good internal consistency, ranging from 0.72 to 0.88 (Sorongon, Kim, & Zill, 2000).

Procedures

All parents gave written consent, and children gave written assent. Schools provided a letter of participation submitted to the IRB and an external Data Safety and Monitoring Board monitored all procedures.

Social Network Surveys (including brief demographic information) were administered to all consented children in classrooms at three time points – before intervention, at the end of intervention and at follow-up. Interventionists did not administer surveys, to reduce the likelihood of social desirability in student responding at the end of treatment and follow-up. Teachers were asked to complete the TPSS for the child with ASD at the same three time points. Within the same week of distributing classroom measures, blinded research personnel gathered two behavioral observations on the playground. These observations were also conducted once during each treatment week, twice at the end of the 6-week treatment phase and twice at a follow-up visit 12 weeks after treatment ended.

Statistical analysis

The two primary outcomes of this study were SNS scores and observed social engagement on the playground (solitary play and joint engagement). Statistical models were used to test the main effects of PEER and CHILD, as well as their interaction. Treatment outcome at posttreatment for social network measures and secondary outcomes (self- and teacher report) was examined using 2×2 analysis of covariance (ANCOVA) models, controlling for pretreatment scores. We controlled for classroom size in all of the models where class size affected children's possible outcomes (i.e. the

number of indegrees, outdegrees, and rejections). Cohen's d effect sizes were computed for significant effects (e.g. $M_{PEER} - M_{NO\ PEER} / SD_{POOLED}$; Cohen, 1988). Comparable analyses were conducted for follow-up scores on these measures, again controlling for pre-treatment scores. For the playground observation data, the 12 time points (two pre, six weekly, two post, two follow up) of data were examined using hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002).

The follow-up period for some children with ASD was conducted after the summer break where they moved to the next grade in a new classroom or a different school with a new set of classmates [$n = 23$ (20 males, 3 females); $M_{age} = 6.87$, $SD_{age} = 2.51$ years old; $M_{IQ} = 90.41$, $SD_{IQ} = 16.72$]. As results were not different for the entire sample at follow-up, irrespective of whether they remained in the same classroom or changed classrooms ($N = 59$; 1 child was homeschooled), all 59 children were used in the follow-up analyses.

Results

Baseline characteristics

One-way analyses of variance yielded no significant differences between the treatment groups on IQ, age and grade; however, there was a significant difference in the number of female participants by treatment conditions, $F(3, 56) = 4.96$, $p = .004$. Five of the six female participants were randomized to the peer-mediated condition, whereas the remaining female participant was randomized to the inclusion only control condition. Gender was thus used as a covariate in subsequent analyses. There were no other pre-treatment differences on any of the outcome measures.

Treatment effects – primary outcome measures

Social network salience. The ANCOVA (controlling for baseline scores and gender) for *posttreatment scores* indicated that there was a significant group effect on SNS scores, $F(5, 54) = 5.11$, $p = .001$, with a significant main effect of the PEER intervention, $F(1, 54) = 8.79$, $p = .004$, $d = 0.79$ and interaction effect $F(1, 54) = 4.05$, $p = .05$. A marginally significant main effect was observed for the CHILD intervention, $F(1, 54) = 3.80$, $p = .06$, $d = 0.36$. SNS increased for groups that had a peer-mediated component ($M = 0.50$; $SD = 0.04$) compared to those groups without a peer component ($M = 0.32$; $SD = 0.04$). Post hoc comparisons showed that children who received both the CHILD and PEER interventions had significantly higher SNS scores ($M = 0.60$; $SD = 0.30$) when compared to children who received the CHILD intervention ($M = 0.31$; $SD = 0.21$), $t(28) = -2.99$, $p = .006$, $d = 1.12$, as well as those who received neither CHILD nor PEER intervention ($M = 0.32$; $SD = 0.15$), $t(28) = 3.23$, $p = .003$, $d = 1.18$. There was a marginally significant difference between children who received both the CHILD and PEER interventions and children who received

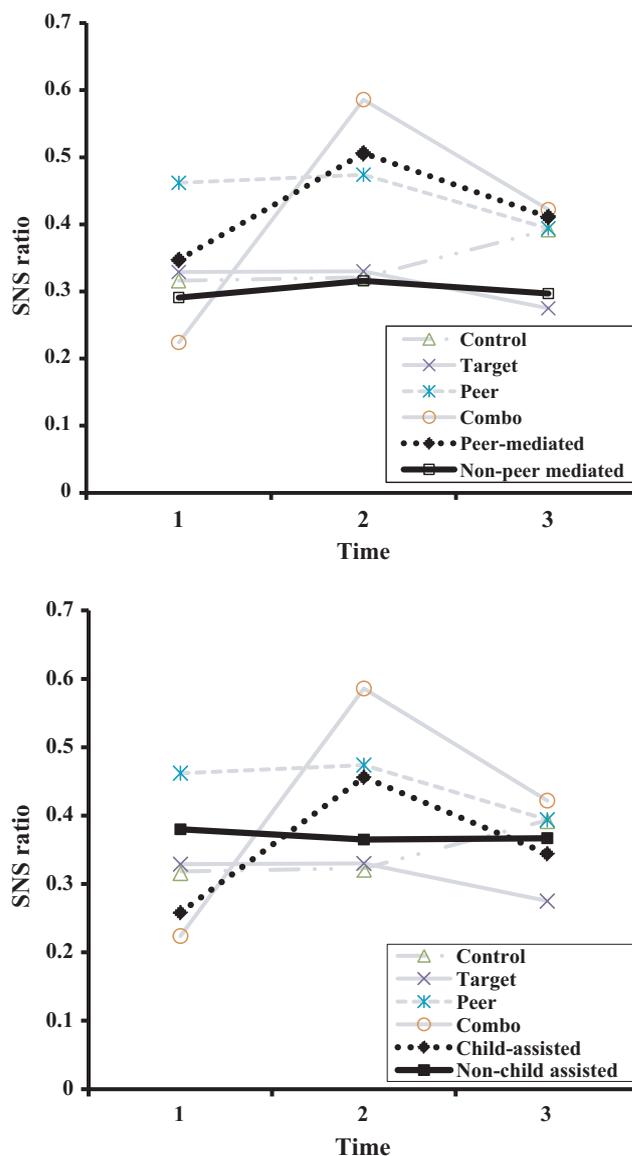


Figure 2 Social network salience (ratio scores) between treatment groups at baseline, exit and a 12-week follow-up

the PEER intervention ($M = 0.41$; $SD = 0.25$), $t(28) = -1.84$, $p = .077$, $d = 0.69$ (see Figure 2 and Table 2).

The ANCOVA (controlling for baseline scores and gender) for *follow-up scores* also indicated that there was a significant effect of treatment group on SNS scores, $F(5, 53) = 3.51$, $p = .008$. There was a significant interaction between PEER and CHILD, $F(1, 53) = 5.51$, $p = .02$, but no main effects were observed for the PEER, $F(1, 53) = 1.33$, $p = .26$, or CHILD, $F(1, 53) = 0.46$, $p = .50$, interventions. Post hoc comparisons at follow-up showed that children who received both the CHILD and PEER interventions had significantly higher SNS ($M = 0.45$; $SD = 0.26$) when compared to children who received CHILD ($M = 0.23$; $SD = 0.19$), $t(27) = -2.62$, $p = .014$, $d = 0.97$, but were not significantly different from children who received PEER ($M = 0.37$; $SD = 0.33$), $t(28) = -0.72$, $p = .48$, as well as those

Table 2 Means and standard deviations for friendship variables and teacher reports of social skills

	Assigned to CHILD			Not assigned to CHILD			Assigned to PEER			Not assigned to PEER		
	Baseline	Follow-up	Exit	Baseline	Follow-up	Exit	Baseline	Follow-up	Exit	Baseline	Follow-up	Exit
Social network salience	0.26 (0.22)	0.34 (0.25)	0.46 (0.29)	0.38 (0.26)	0.37 (0.21)	0.37 (0.21)	0.35 (0.29)	0.41 (0.29)	0.51 (0.29)	0.29 (0.19)	0.41 (0.29)	0.32 (0.18)
Received friendship nominations (range 0–8)	1.23 (1.48)	1.41 (1.52)	2.00 (2.10)	1.80 (1.83)	1.53 (1.49)	2.33 (1.49)	1.80 (2.01)	1.73 (1.76)	2.80 (1.96)	1.23 (1.22)	1.73 (1.76)	1.53 (1.43)
Outward nominations (range 0–15)	4.27 (2.89)	4.10 (2.43)	4.67 (2.20)	3.43 (2.49)	3.40 (2.19)	4.43 (3.22)	4.17 (2.93)	4.10 (2.54)	4.63 (2.28)	3.53 (2.47)	4.10 (2.54)	4.47 (3.17)
Rejection nominations (range 0–9)	1.71 (2.02)	2.15 (2.54)	2.11 (2.82)	1.69 (1.85)	1.93 (1.91)	2.03 (1.80)	2.17 (2.07)	2.40 (2.27)	2.37 (2.25)	1.19 (1.62)	2.40 (2.27)	1.74 (2.43)
Reciprocal friendships (%age) (range 0–100)	6.25 (25.00)	12.50 (34.16)	15.79 (37.46)	18.18 (40.45)	5.56 (23.57)	13.33 (35.19)	13.33 (35.19)	10.00 (30.78)	13.64 (35.13)	8.33 (28.87)	10.00 (30.78)	16.67 (38.93)
Teacher perceptions	23.31 (4.61)	24.18 (3.33)	24.76 (4.05)	23.31 (3.63)	23.97 (4.20)	24.62 (4.47)	23.13 (4.02)	24.95 (3.72)	25.19 (3.45)	23.51 (4.27)	24.95 (3.72)	23.49 (4.26)

ns are listed for reciprocal friendships due to the small number of available data. When one of the students nominated was missing a survey, data were coded as missing.

who received neither CHILD nor PEER ($M = 0.36$; $SD = 0.29$), $t(28) = 0.90$, $p = .38$.

Playground engagement. A conditional HLM model tested the hypothesis that assignment to the PEER and CHILD treatments would be associated with a reduction in observed solitary engagement on the playground over the course of treatment and follow-up, in comparison to not being assigned to these treatment conditions. As with the ANCOVA models, a PEER \times CHILD interaction term was also included to test for a synergistic effect. In this model, the time by PEER treatment interaction term was statistically significant ($t = -2.39$, $p = .02$), but the comparable model for the CHILD treatment was not ($t = -1.10$, $p = .27$). The time by PEER \times CHILD term also was not significant ($t = -0.93$, $p = .35$). There was a faster decline over time in children's solitary engagement on the playground for children randomized to the PEER condition than for children not randomized to the PEER condition.

To explore the HLM results, two post hoc ANCOVAs were conducted. Average scores across the two observations at baseline, posttreatment, and follow-up were computed (see Table 3). Solitary engagement at the end of treatment was not different for PEER, $F(1, 53) = 0.03$, $p = .86$ or CHILD, $F(1, 53) = 0.72$, $p = .40$ but was significant at follow-up, $F(5, 53) = 8.34$, $p = .000$, for PEER, $F(1, 53) = 14.68$, $p = .000$, $d = 0.94$, but not for CHILD, $F(1, 53) = 0.10$, $p = .75$.

In the model testing joint engagement, the time by PEER treatment group was marginally significant ($t = 1.91$, $p = .056$); the comparable model for the CHILD treatment was not significant ($t = -1.28$, $p = .20$). The time by PEER \times CHILD term also was not significant ($t = 1.14$, $p = .26$).

Post hoc ANCOVA models were similar to the above models with no significant differences in joint engagement at posttreatment for PEER, $F(1, 53) = 0.003$, $p = .95$ or CHILD, $F(1, 53) = 0.003$, $p = .96$. However, significant effects of treatment on joint engagement at follow-up were found, $F(5, 53) = 5.50$, $p = .000$. Joint engagement was significantly higher at follow-up for PEER, $F(1, 53) = 8.45$, $p = .005$, $d = 0.77$, but not for CHILD, $F(1, 53) = 0.37$, $p = .54$.

Treatment effects – secondary outcome measures

Received friendship nominations. The ANCOVA (controlling for baseline scores and gender) for *post-treatment scores* indicated that there was a significant group effect on received friendship nominations (indegrees), $F(6, 53) = 6.50$, $p = .000$, with a significant main effect for PEER, $F(1, 53) = 5.69$, $p = .02$, $d = 0.74$, but not CHILD, $F(1, 53) = 0.005$, $p = .95$, or an interaction effect, $F(1, 53) = 0.07$, $p = .79$. From posttreatment to follow up, the ANCOVA yielded

Table 3 Means and standard deviations for playground engagement levels (in proportions of intervals)

	Baseline		Exit		Follow-up	
	CHILD	PEER	CHILD	PEER	CHILD	PEER
Solitary engagement						
Mean	0.36	0.34	0.33	0.28	0.33	0.19
SD	0.29	0.29	0.27	0.26	0.30	0.24
Joint engagement						
Mean	0.41	0.43	0.43	0.44	0.43	0.51
SD	0.34	0.34	0.27	0.31	0.35	0.34

Scores are averaged across 2 days of observations at baseline, posttreatment and follow-up. CHILD, child-assisted approach; PEER, peer-mediated approach.

ded nonsignificant differences for the PEER conditions, $F(1, 53) = 1.08$, $p = .30$ (see Table 2).

Nominations of friendships. Outward friendship nominations (outdegrees) were not significantly different among groups at posttreatment, $F(6, 53) = 1.83$, $p = .11$, or at follow-up $F(6, 52) = 0.71$, $p = .65$ (see Table 2).

Rejections. The average number of received rejections was relatively low with no group differences at any time point (see Table 2).

Reciprocal friendships. Reciprocal friendship rates were nonsignificant among groups at all time points.

Teacher perceptions social skills. Teachers ratings of children's social skills significantly changed from baseline to posttreatment, $F(5, 49) = 14.10$, $p = .000$, with a significant main effect for PEER, $F(1, 49) = 6.45$, $p = .01$, $d = 0.44$. Teachers rated students with ASD as having significantly better social skills posttreatment in the PEER condition. No differences were found for the CHILD condition or the interaction of CHILD and PEER, $F(1, 49) = 0.18$, $p = .67$, and $F(1, 49) = 0.001$, $p = .97$, respectively. ANCOVA at follow-up yielded no significant differences for PEER, $F(1, 49) = 2.53$, $p = .12$, or for CHILD, $F(1, 49) = 0.37$, $p = .55$.

Discussion

This study begins to address the gaps in our knowledge about the efficacy of peer-mediated and child-assisted interventions at school for children with ASD. The treatments were targeted in 12 sessions with a 12-week follow-up. Child outcomes were measured through direct observations, and peer, self and teacher reports. Overall, results indicated that peer-mediated treatments were superior to non-peer-mediated treatments on several outcomes and these treatment gains persisted to follow up.

A main outcome was that classroom-wide-rated SNS improved for children with ASD over a short period of time when they received both interventions.

Using ratio scores that controlled for class size, baseline scores, and composition, children with ASD who received both a PEER and a CHILD treatment made the greatest gain in SNS with a large effect size. Overall, the PEER interventions yielded greater movement toward more central roles in classroom social networks than CHILD interventions in a short time frame. Changes in child-mediated approaches have smaller and more temporary effects.

Secondary measures also favored children who were in the peer-mediated interventions. Children received more friend nominations from their peers, even those who were not peer models, and were observed as less isolated on the playground at the end of treatment when involved in peer-mediated interventions whereas no significant changes were observed for children in the child-assisted interventions. Teachers also rated children in the peer-mediated interventions as doing better socially in the classroom after treatment suggesting that PEER interventions directly impacted the child with autism. Greater evidence of this impact is that even when the child with autism changed classrooms the next year (with new peers) their SNS remained similar to the gains at the end of treatment, suggesting the difference was in part due to changes in the child with autism. Thus, using a variety of methods, children in the peer-mediated interventions performed better on a number of our outcome measures with gains persisting over a 3-month follow-up.

Our findings raise several issues. One concerns the outcomes that did not change. Reciprocal friendships remained low and stable for children with ASD. While classmates nominated the child with ASD as a friend more often at the end of treatment and at follow-up when exposed to a peer-mediated intervention, the children with ASD did not reciprocate these nominations. Indeed it is possible that the children with ASD did not recognize these friendship opportunities. As friendship development was not a primary target of the treatments it may not be surprising that reciprocal friendships did not improve. To improve this area of social development, direct targeting may be necessary and/or the intervention itself must be of greater intensity or dose.

Another issue concerns the effects of the interventions on children's behavior on the playground. Using growth-modeling techniques, we noted that only for the peer-mediated groups, did children decrease their solitary play on the yard and move toward more engagement in games and conversations, and these effects were greatest at the follow-up. While these data suggest some positive change for children on the playground, they also highlight how difficult change can be for children in this complex social arena. Only through the help of peers over time did children become less isolated, but even having peers who considered them friends was not enough to improve all areas of child engagement on the playground. These data suggest that it may be necessary to conduct interventions on the playground itself to significantly improve social interactions with peers.

A third issue concerns the effect of being a peer model – both in terms of how trained peers affect the data, and the effect of being a peer model on their own social status. For example, peers could potentially respond to social expectations and nominate the child with ASD to their social group, thus accounting for the change in SNS and increased friendship nominations. While the data indicate that our typical peer models did nominate the child with ASD to their social groups after treatment, nonpeer model children also nominated the child with ASD (Locke, Kasari, & Rotheram-Fuller, 2009). Did being a peer model affect their social status? We saw no drop in social network centrality for the typical peers who served as the peer models (Locke et al., 2009). Indeed, our peers were most often socially adept children who remained at high status throughout and after the intervention.

Finally, these data suggest a major shift in our delivery of social skills interventions to children with ASD. The most common approach is to offer an *off campus, clinic-based* social skills group directly targeting the child with ASD. Reviews of these studies suggest that children learn important social skills in the group format but that these skills do not generalize to their natural environments (Bellini et al., 2007; Rao et al., 2008; Williams White et al., 2007). Moreover, the group composition is often of other children with social challenges who are not from the same class or school. Our data suggest that interactions with typical classmates can improve social networks at school. Although it is unknown how many students in the class were affected by the intervention (i.e. beyond the trained models), it is clear that increasing peer tolerance and engagement can be powerful change agents for children with ASD. The effects of the intervention also persisted over a 3-month follow-up period, suggesting that peers continued their involvement when no additional support was provided. Moreover, peers appeared to affect the behavior of the children with autism since even when the child with autism

changed classes with new sets of peers their SNS remained stable.

The most common *school-based intervention* for children with ASD is to assign a one-on-one assistant to help the child with ASD navigate the school environment. The assistant is often charged with helping the child socially integrate with peers. Existing data suggest limited advantages to this approach (Humphrey & Lewis, 2008; Kasari et al., 2011), but the approach itself has not been rigorously tested. The data from the current study suggest that child-assisted approaches made little change in the child's ability to engage with their peers despite an individualized intervention approach that targeted specific social difficulties of the child with ASD. Only when paired with concurrent peer-mediated intervention was the child-assisted approach effective. It could be that children were too young to advocate for themselves, or too unaware of their own social situation to make necessary changes to engage with their peers. The time frame of intervention may also have been too short or alternatively, one-on-one assistants may mark children with ASD as different, and inadvertently supplant or interfere with more developmentally appropriate peer relationships. Future studies are needed that examine the use of social groups and adult assistance at school, and that vary the group composition to determine the greatest effect on children's social outcomes.

The current study represents one of the largest intervention samples for children with ASD at school; yet, the sample was too small to test mediators and moderators of treatment effects. Future studies should involve larger samples of children (especially females), include playground observations on peers as well as children with ASD, and carefully consider comorbidities that may affect treatment outcomes (Antshel et al., 2011). Another limitation is that working with school calendars is difficult, and in this study, many of the children changed classrooms or schools (and thus peer groups) by the time of the follow-up. Despite these limitations, this study has methodological strengths over previous studies. The study was conducted in authentic school environments utilizing a randomized controlled design and implemented by trained research staff (considered a partial effectiveness trial). Independent testers blind to study hypotheses administered assessments, blinded observers conducted playground observations, and multiple informants provided outcome measures.

In summary, the educational setting of the school offers unique opportunities to teach typical peers to become sensitive and helpful toward peers with different learning or developmental needs. These results support the view that working with peers may be the most effective and ecologically valid approach for improving the social outcomes of children with ASD. Future studies should consider effectiveness

trials in which school personnel carry out the interventions with the goal that both intervention dose and generalization are maximized.

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Correspondence to

Connie Kasari, University of California, 760 Westwood Plaza, Los Angeles, CA 90024, USA; Email: kasari@gseis.ucla.edu

Key points

- Peer-mediated interventions produce greater social involvement than child-mediated interventions for children with autism spectrum disorders.
- Brief, 12-session interventions can affect change.
- Improvements in socialization can be maintained for up to 3 months after treatment has ended.
- Using multiple informants provides a more accurate, robust picture of social involvement of children with autism spectrum disorders in the classroom.

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