



Exploring the Effectiveness of a Peer-Mediated Model of the PEERS Curriculum: A Pilot Randomized Control Trial

Nicole L. Matthews¹ · Beatriz C. Orr¹ · Katrina Warriner¹ · Mary DeCarlo¹ · Mia Sorensen¹ · Jessica Laflin¹ · Christopher J. Smith¹

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Abstract

This study compared immediate and 4-month outcomes among adolescents with autism spectrum disorder randomly assigned to the PEERS curriculum ($n = 10$), a peer mediated PEERS curriculum ($n = 12$), or a delayed treatment control group ($n = 12$). Findings suggest a modest advantage in social skills knowledge and social functioning for participants in the peer-mediated PEERS curriculum relative to Traditional PEERS, and gains in social skills knowledge, social functioning, and reductions in loneliness were maintained in one or both treatment groups at a 4-month follow-up. Typically developing peer mentors ($n = 16$) showed improvements in social skills knowledge and marginal improvements in autism knowledge and loneliness. Future research with a larger sample and objective outcome measures is needed.

Keywords Autism spectrum disorder · PEERS curriculum · Social skills intervention · Adolescents · Peer-mediated

Introduction

Recent prevalence reports indicate that 69% of individuals with autism spectrum disorder (ASD) are intellectually able (i.e., IQs < 70; CDC 2014). Despite the majority of individuals with ASD having the intellectual capacity to pursue typical postsecondary or vocational paths, many lack requisite skills for success in educational and vocational environments (Camarena and Sarigiani 2009) due to the social

communication impairments that characterize the disorder (American Psychiatric Association 2013). This trend is evidenced by low college matriculation rates and high unemployment rates (Levy and Perry 2011). The improvement of social skills in adolescents and adults with ASD without intellectual disability is important because better social integration may lead to success in multiple environments (Laugeson et al. 2009), and ultimately, improved quality of life.

The PEERS curriculum (Laugeson and Frankel 2010) is one of the most well-studied social skills interventions for this demographic. Research indicates that participants demonstrate significant reductions in autism symptoms, problem behaviors, social anxiety, and/or increases in social skills, and social contact with peers (Gantman et al. 2012; Laugeson et al. 2009, 2012; Schohl et al. 2013; Van Hecke et al. 2015). However, the potential for increasing effectiveness of the intervention using peer mediation strategies remains unexamined, and little is known about potential collateral effects on adolescent well-being. The current study aimed to examine these issues.

The PEERS Curriculum

The PEERS curriculum is a manualized 14-week intervention that teaches social and friendship skills to intellectually able adolescents with ASD. During weekly 90-min sessions,

✉ Nicole L. Matthews
nmatthews@autismcenter.org

Beatriz C. Orr
borr@autismcenter.org

Katrina Warriner
kwarriner@autismcenter.org

Mary DeCarlo
mdecarlo@autismcenter.org

Mia Sorensen
msorensen@autismcenter.org

Jessica Laflin
jlafin@autismcenter.org

Christopher J. Smith
csmith@autismcenter.org

¹ Southwest Autism Research and Resource Center, 300 N 18th Street, Phoenix, AZ 85006, USA

small groups of adolescents are taught social skills using didactic lessons, role plays, and behavioral rehearsals. Parents are trained to coach their adolescents as they complete weekly homework assignments related to the course material (Laugeson and Frankel 2010).

A growing body of evidence supports efficacy of the PEERS curriculum. In an initial randomized control trial (RCT; Laugeson et al. 2009), the treatment group demonstrated significant improvements relative to a control group in adolescent social skills knowledge, adolescent-reported get-togethers, and parent-reported social skills. In a second RCT, Laugeson et al. (2012) replicated their initial findings and also observed improvements in parent-reported hosted get-togethers and autism symptomology. The majority of gains were maintained at a 14-week follow-up, and additional gains were observed in the form of reduced problem behaviors, improved social awareness, and teacher-reported improvements in social functioning.

Schohl et al. (2013) conducted an independent replication of the previous RCTs with a relatively large sample ($n=58$). Results were mostly consistent with the previous studies. Inconsistencies included the treatment group adolescents reporting greater increases in invited get-togethers relative to the control group, no significant differences between the treatment and control groups in parent-reported get-togethers, and teacher-reported reductions in problem behaviors in the treatment group. Extending previous research, the authors reported a significant reduction in social anxiety in the treatment group (Schohl et al. 2013).

Van Hecke et al. (2015) investigated whether participation in the PEERS program is associated with changes in neural activity. EEG findings suggested an association between the behavioral improvements observed in adolescents who completed the PEERS curriculum and changes in brain activity that approximated patterns observed in typically developing (TD) adolescents (Van Hecke et al. 2015). These findings represented an important step toward more objective outcome measures to supplement parent-, adolescent-, and teacher-report.

The majority of previous research on the PEERS curriculum has been conducted in university settings where the intervention was administered by the authors of PEERS (Laugeson et al. 2009, 2012) or by certified PEERS providers (Schohl et al. 2013; Van Hecke et al. 2015). Notably, these clinicians had either doctoral degrees or were graduate students enrolled in doctoral programs. It remains unclear whether outcomes reported in these studies are realized by participants in community-based settings characterized by staff with less advanced terminal degrees and different logistical considerations such as sharing staff with other intervention programs and clinicians who may not be able to dedicate as much time to implementing the intervention relative to research faculty and doctoral students. These possibilities

are consistent with the previously identified “research-to-practice gap in autism intervention” (e.g., Dingfelder and Mandell 2011; Lord et al. 2005), which is characterized by challenges related to dissemination and appropriate implementation of interventions developed and tested in university settings. Thus, additional research is necessary to determine whether similar outcomes are observed when the PEERS curriculum is implemented in non-university settings.

Peer-Mediated Interventions for ASD

A large volume of research has examined the feasibility and effectiveness of, as well as concerns related to, peer-mediated interventions for children and adolescents with ASD (Chan et al. 2009; Watkins et al. 2015). Overall, these interventions appear to be effective with no observable negative effects for peers or individuals with ASD (Chan et al. 2009). Additionally, research suggests that peer-mediated social competence interventions may increase generalization of skills (Schmidt and Stichter 2012; Watkins et al. 2015). Less is known about the relative efficacy of peer-mediated interventions compared to interventions delivered without peer mediation, and two RCTs have reported mixed results. In the first, children with ASD who were administered a peer-mediated social skills intervention demonstrated better social outcomes compared to children administered an intervention delivered by a trained adult interventionist (Kasari et al. 2012). In the second, children who completed a didactic social skills group with other children with ASD demonstrated improved peer acceptance and social engagement relative to children who completed a peer-mediated intervention that focused on interaction with TD peer models (Kasari et al. 2016). In interpreting these findings, Kasari et al. (2016) suggested that the direct instruction and opportunities for practice experienced by children in the didactic social skills group may have been more effective than facilitated interactions with TD peers. To our knowledge, previous research has not examined the relative efficacy of didactic social skills groups with and without peer mediation.

Consistent with research indicating benefits of peer mediation (Chan et al. 2009; Watkins et al. 2015), the non-profit autism center where the current study was conducted integrates peer mentors into the majority of its intervention models. When the center first began implementing the PEERS curriculum in 2013, it recruited TD peer mentors to participate to maintain consistency with its other clinical programs. Researchers at the autism center sought to examine whether including TD peer mentors improves effectiveness of the PEERS curriculum. In the current study, the peer-mediated version of the intervention was identical to the manualized PEERS curriculum, with the addition of two peer-mediated intervention strategies: proximity and peer initiation (Odom

and Strain 1984), which are discussed in detail in the “Method” section.

Adolescent Well-Being

Individuals with ASD without intellectual disability often have insight into their social difficulties, which may play a role in the heightened loneliness and depression observed in this population (Lasgaard et al. 2010; Schohl et al. 2013; Strang et al. 2012). Anxiety is a common comorbid disorder (Grondhuis and Aman 2012), and anxiety and depression symptoms are more prevalent in children and adolescents with high functioning ASD compared to their TD peers (Wood and Gadow 2010; Strang et al. 2012). The stress of social situations likely plays a role in depression and anxiety among adolescents with ASD (Wood and Gadow 2010). It is possible that social skills interventions yield collateral effects beyond improved social skills, including reduced social anxiety (Schohl et al. 2013) and loneliness.

The Current Study

Using a randomized control design, the current study compared the effectiveness of a peer-mediated PEERS model (henceforth referred to as PEERS with Peers, or PwP), characterized by a 1-to-1 ratio of TD adolescents to adolescents with ASD, to the traditional PEERS curriculum and a delayed treatment control group (DTC). All PEERS sessions were administered at a community-based non-profit autism center by Master’s and Bachelor’s level clinicians without current university affiliations. Specific aims were to: (1) compare change in social skills knowledge, social functioning, get-togethers, and well-being between ASD study groups, and (2) explore change in the same variables, as well stigma related to ASD and autism knowledge in TD peer mentors. The second aim was included to better understand the impact of serving as a peer mentor. Primary outcome variables were measured at intervention entrance and exit, as well as a 4-month follow-up in participants with ASD to assess potential maintenance of acquired skills. It was predicted that adolescents with ASD who completed PwP would demonstrate the largest gains in social skills knowledge, social functioning, get-togethers, and well-being, followed by adolescents who completed Traditional PEERS, and then adolescents in the DTC group. It was also predicted that TD peer mentors would demonstrate reduced stigma and increased autism knowledge from pre-to-post PEERS participation.

Method

Design

All study procedures were approved by the Western Institutional Review Board. Participants with ASD were randomly assigned using a random number generator to Traditional PEERS, PwP, or the DTC group. Eight PEERS groups were completed over a 2-year period. Each year, one Traditional PEERS group and two PwP groups were run concurrently from August to December. A Traditional PEERS group was held each summer for the DTC group.

Participants

Participants with ASD

Participants were recruited using the autism center’s database of families who have agreed to be contacted about research studies. A study recruitment flyer was also posted to the autism center’s website and social media pages, and was shared with other local autism organizations. Inclusion criteria were: (1) an independent DSM-IV or DSM-5 ASD diagnosis confirmed by classification of autism or autism spectrum on the ADOS-2 (Lord et al. 2012); (2) adolescent aged 13–17 years and in high school (grades 9–12); (3) adolescent spent at least 80% of educational time in general education setting at an in-person high school; home schooled and on-line students were excluded due to an additional ongoing component of the study that involves examination of social networks at school; (4) parent report that the adolescent has difficulty making and/or keeping friends; (5) adolescent willingness to participate in PEERS; (6) parent willingness and ability to attend the intervention and serve as a social coach; (7) verbal IQ of 70 or above, and (8) willingness to be randomly assigned to a study group.

Recruitment, assessment, and randomization procedures are reported in Fig. 1. A parent or caregiver of 99 potential participants with ASD who met age and grade-level inclusion criteria completed a phone screen. Thirty-seven potential participants were determined to be ineligible based on the inclusion criteria, and 16 indicated that they were not interested in participating in the study. The remaining participants ($n = 46$) completed an intake visit, during which they provided consent and completed assessments to confirm inclusion criteria. Two participants were excluded after intake: one did not meet criteria for verbal IQ, and one was selectively mute and unable to verbally participate in a group setting. Participants were enrolled in cohort 1 ($n = 19$) or cohort 2 ($n = 25$) and were

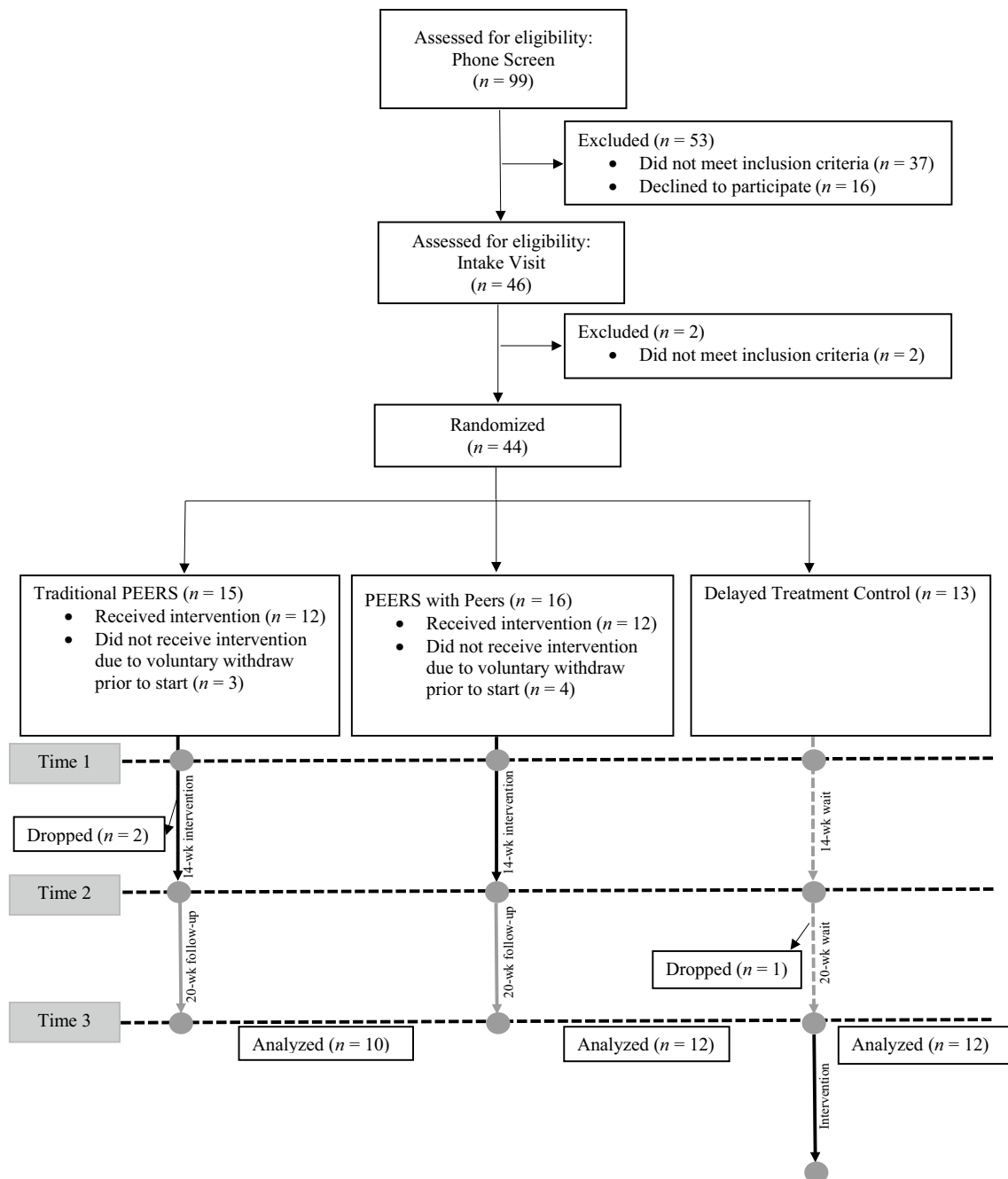


Fig. 1 Recruitment, assessment, and randomization of participants with autism spectrum disorder

randomized to a study group: Traditional PEERS ($n = 15$), PwP ($n = 16$), or the DTC group ($n = 13$). Prior to time 1, six participants voluntarily withdrew from the study. Four families could not make the time commitment; the remaining two were not responsive to contact attempts. During the intervention, three Traditional PEERS participants withdrew for scheduling or personal family reasons. One participant in the DTC group was lost to follow-up at the third time point.

Thirty-four participants with ASD who completed all three time points were included in the current analyses: ten in Traditional PEERS, 12 in PwP, and 12 in DTC. One parent or caregiver of each participant also participated ($n = 28$ mothers; three fathers; two stepmothers, and one stepfather). Descriptive statistics for diagnostic and demographic variables, including parent-reported comorbid psychiatric disorders, are reported in Table 1. There was approximately a 4:1 ratio of males to females with ASD, which is consistent with

Table 1 Demographic information for participants with autism spectrum disorder

	Traditional PEERS (<i>n</i> = 10)	PEERS with Peers (<i>n</i> = 12)	DTC (<i>n</i> = 12)
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Age (years)	15.10 (1.29)	15.17 (1.27)	15.42 (1.08)
Male (%)	80.00	83.33	83.33
KBIT-2			
Composite IQ	97.00 (17.44)	102.83 (18.39)	101.25 (18.81)
Verbal IQ	96.90 (11.86)	100.42 (20.92)	96.83 (18.00)
Nonverbal IQ	96.90 (20.72)	104.50 (16.01)	104.92 (16.45)
ADOS-2 Comparison Score	7.90 (1.59)	8.25 (1.42)	8.08 (1.68)
Vineland-II Adaptive Behavior Composite	71.60 (8.98)	70.83 (9.33)	71.67 (7.05)
Race (%)			
African American	0.00	0.00	8.30
Asian American	0.00	8.30	0.00
Caucasian	100.00	83.30	75.00
Hispanic	0.00	8.30	16.70
Maternal education (%)			
High school degree	0.00	8.30	0.00
Some college	10.00	25.00	16.70
College degree	40.00	50.00	50.00
Graduate degree	40.00	8.30	33.30
Did not report	10.00	8.30	0.00
Annual household income (%)			
\$40,001–\$60,000	0.00	25.00	8.30
\$60,001–\$80,000	20.00	8.30	16.70
\$80,001–\$100,000	20.00	33.30	41.70
>\$100,000	40.00	33.30	33.30
Did not report	20.00	0.00	0.00
Parent-reported comorbidities (%)			
None	40.00	25.00	42.00
ADHD	20.00	17.00	33.00
Anxiety or depression	10.00	8.30	0.00
Bipolar-NOS	0.00	8.30	0.00
Mitochondrial disorder	0.00	8.30	0.00
Multiple ^a	30.00	33.00	25.00

DTC delayed treatment control group, *KBIT-2* Kaufmann Brief Intelligence Test, Second Edition, *ADOS-2* Autism Diagnostic Observation Schedule, Second Edition, *Vineland-II* Vineland Adaptive Behavior Scales, Second Edition, Parent Survey Form, *ADHD* attention deficit hyperactivity disorder, *NOS* not otherwise specified

^aParticipants had 2–3 comorbid psychiatric disorders including ADHD, generalized anxiety disorder, depressed mood, mild cerebral palsy, obsessive compulsive disorder, dysthymia, learning disability, and/or bipolar NOS

current prevalence estimates (Christensen et al. 2016). One-way ANOVAs indicated no significant between group differences in participant age, composite IQ, verbal IQ, nonverbal IQ, adaptive behavior scores (Vineland-II; Sparrow et al. 2005), or ADOS-2 comparison scores (Lord et al. 2012), nor were there significant group differences in time 1 scores for any of the outcome variables (Tables 3, 4). Participants were predominately Caucasian and from middle- to upper-middle

class families. Fisher's exact tests indicated no significant between group differences in race, maternal education, or household income.

Typically Developing Peer Mentors

Adolescents between the ages of 13 and 17 years without a known psychological or developmental disorder were

Table 2 Demographic information and descriptive statistics for typically developing peer mentors ($n = 16$)

	Time 1 <i>M (SD)</i>	Time 2 <i>M (SD)</i>	Cohen's <i>d</i> (size)
Age (years)	15.50 (1.27)		
Percent male	43.80		
Race (%)			
Asian American	18.75		
Caucasian	75.00		
Hispanic	6.25		
Maternal education (%)			
High school degree	6.25		
Some college	0.00		
College degree	18.75		
Graduate degree	43.75		
Did not report	31.25		
Annual household income (%)			
\$20,001–\$40,000	6.25		
\$40,001–\$60,000	0.00		
\$60,001–\$80,000	6.25		
\$80,001–\$100,000	0.00		
>\$100,000	50.00		
Did not report	37.50		
SRS Total <i>T</i> -score	41.50 (2.78)	41.88 (3.28)	0.10 (negligible)
SSIS Social Skills	110.75 (9.88)	113.25 (11.12)	0.43 (small)
SSIS Problem Behaviors	93.25 (7.88)	91.13 (5.32)	0.29 (small)
TASSK*	15.63 (4.03)	24.00 (3.06)	2.33 (large)
SIAS	13.19 (5.72)	11.25 (6.01)	0.26 (small)
SIAS (extreme outlier excluded)	12.27 (4.53)	11.73 (5.89)	0.11 (negligible)
R-UCLA [†]	28.94 (4.95)	26.06 (4.78)	0.69 (medium)
QSQ-hosted			
Parent	3.13 (2.36)	3.63 (2.28)	0.17 (negligible)
Adolescent	3.25 (1.57)	4.25 (2.86)	0.37 (small)
QSQ-invited			
Parent [†]	1.75 (1.84)	3.25 (2.38)	0.57 (medium)
Adolescent	3.25 (2.30)	4.38 (2.78)	0.34 (small)
Social Distance Scale	7.81 (1.52)	7.56 (1.15)	0.18 (negligible)
Autism Knowledge Questionnaire	27.38 (4.27)	28.13 (4.65)	0.21 (small)
Autism Knowledge Questionnaire [†] (extreme outlier excluded)	27.33 (4.42)	28.80 (3.91)	0.66 (medium)

SRS Social Responsiveness Scale, SSIS Social Skills Improvement System, TASSK Test of Adolescent Social Skills, SIAS Social Interaction Anxiety Scale, R-UCLA Revised UCLA Loneliness Scale, QSQ-P/A Quality of Socialization Questionnaire-Parent/Adolescent

* $p < .001$; [†] $p < .05$

also recruited from the autism center's database (i.e., peer mentors for other programs, TD controls from completed research studies, and/or siblings of clients with ASD) and through distribution of a recruitment flyer on the autism center's social media page and to local charter schools. A total of 16 TD peer mentors participated in the study; 8 in each cohort. One additional peer mentor was consented, but withdrew from the study due to a scheduling conflict. Similar to the ASD sample, TD peer mentors were predominately

Caucasian and from middle- to upper-middle class families. Demographic information and descriptive statistics for this subsample are reported in Table 2. Peer mentors were made aware of the same attendance expectations as the participants with ASD (i.e., participants were allowed no more than two absences), and were encouraged to miss as few sessions as possible in order to maintain a minimum 1:1 ratio of peer mentors to participants with ASD. Number of TD peer mentor absences ranged from 0 to 2 ($M = 1.13$, $SD = 0.81$).

Procedures

Phone Screen

A member of the research team conducted a 15-min phone screening derived from the PEERS manual (Laugeson and Frankel 2010) with parents of potential participants. Families who did not meet inclusion criteria were informed that they were ineligible and provided with information for other social skills groups in the community.

Intake Visit

Informed consent and assent were obtained, and an intake interview derived from the PEERS manual (Laugeson and Frankel 2010) was completed to orient each family to the program, explain participation expectations, and determine appropriateness of the curriculum for each adolescent. A similar intake interview was completed with TD participants to determine whether the adolescent was willing to commit to the responsibilities of being a peer mentor.

Participants with ASD were administered the autism diagnostic observation schedule, Second Edition (ADOS-2; Lord et al. 2012) by a research reliable rater to confirm ASD diagnoses and the Kaufman Brief Intelligence Test (KBIT-2; Kaufman and Kaufman 2004) to confirm IQ requirements for PEERS. One parent of each adolescent with ASD was administered the Vineland Adaptive Behavior Scales Survey Form (Vineland-II; Sparrow et al. 2005).

One parent of each TD peer mentor completed the Social Responsiveness Scale, Second Edition (SRS; Constantino and Gruber 2012) to reduce the likelihood of enrolling a TD peer with social challenges. All TD peer mentors' SRS scores were within normal limits (i.e., non-ASD). The first author completed intake interviews with peer mentors to probe for social challenges and determine whether they had the requisite social skills to serve as a peer mentor.

Data Collection

Data were collected 1 week prior to the start of PEERS (August 2015 or 2016; time 1), the last night of PEERS (November/December 2015 or 2016; Time 2) and at the end of the school year (April/May 2016 or 2017; Time 3). Upon completing the study, all parent–adolescent dyads received a total of \$150 in thanks for their participation.

Intervention

Implementation of the program was supervised by two doctoral-level psychologists who completed certified provider training at the UCLA PEERS Clinic. The clinicians directly implementing the program were existing staff at the autism

center. The parent group clinician was a Master's level counselor and Board Certified Behavior Analyst (BCBA) with 10 years of experience implementing and/or supervising 1:1 intervention programs based on the principles of applied behavior analysis (ABA) for individuals with ASD. Each teen group was co-led by two clinicians; three staff filled these roles. Two were Master's level clinicians. The first had a Master's in counseling and 3 years of previous experience as an ABA service provider for individuals with ASD; this clinician co-led the teen group during the first year. The second was a BCBA with 8 years of professional experience with individuals with ASD; four of which involved implementing ABA-based intervention. This clinician co-led the teen group during the second year. The third Bachelor's level clinician had 1 year of experience implementing ABA-based interventions for individuals with ASD and co-led the teen group throughout the duration of the study.

One of the certified PEERS providers conducted a 3-day training with clinicians that included didactic lessons that covered the guiding principles and format of each session, the content of the curriculum, and a mock PEERS session to allow for the teen group clinicians to practice implementing the curriculum. One-day refresher trainings were conducted prior to the summer 2016 and summer 2017 groups. Prior to training, none of the clinicians had previous experience independently implementing the PEERS curriculum. One of the teen group leaders assisted as a behavioral coach during a previous session of the program administered prior to the current study. One of the certified PEERS providers regularly observed parent and teen sessions to ensure the intervention was implemented appropriately, and fidelity checklists were completed by trained research assistants during every session. During weekly supervision meetings, the clinical team reviewed fidelity of implementation, discussed each case, and reviewed content for the upcoming week.

Traditional PEERS Described in detail elsewhere (Laugeson et al. 2009, 2012), PEERS is a manualized parent-assisted, psychoeducational social skills intervention for adolescents with ASD without intellectual disability. During the 14-week intervention, didactic lessons, role plays, behavioral rehearsals, and homework assignments are used to teach social skills, including conversational skills, choosing appropriate friends, appropriate use of humor, entering and exiting conversations, how to have an appropriate get together, good sportsmanship, how to handle teasing, embarrassing feedback, bullying, bad reputations, disagreements, rumors, and gossip. During a separate simultaneous session, parents learn strategies for helping the teen to apply newly acquired skills in the real world (Laugeson and Frankel 2010).

PEERS with Peers Whereas traditional PEERS exclusively included adolescents with ASD, PwP included at least one TD peer mentor for every adolescent with ASD.

Prior to beginning PEERS, peer mentors and their parents completed a 1-h training on ASD and their roles as peer mentors. The peer-mediated intervention strategies of proximity (i.e., natural social skills transmission through interaction with socially-capable peers) and peer initiation (i.e., TD peers are instructed to make social overtures to adolescents with ASD) were used (Odom and Strain 1984). Specific peer mediation behaviors performed by the peer mentors are described below and are followed with the type of strategy in parentheses. Mentors were instructed to participate in group discussions, but to allow teens with ASD the first opportunity to respond to questions posed by the clinicians (proximity). For behavioral rehearsals, clinicians asked a mentor to go first to demonstrate the skill and alternated turns between mentors and adolescents with ASD (proximity and initiation). Mentors were encouraged to model appropriate social skills and behavior throughout each PEERS meeting (proximity), provide positive reinforcement to all participants (initiation), and to remind teens with ASD of the rules taught by the PEERS curriculum if they were not following the respective rules during behavior rehearsals (initiation). Mentors were reminded of the importance of completing the homework each week, including in-group phone calls with one of the teens with ASD (proximity and initiation), and modeling accurate reporting of homework completion (proximity). If necessary, clinicians would meet separately with peer mentors before or after sessions to remind them of these instructions. Last, mentors were informed that the clinicians would not differentiate between teens with ASD and peer mentors during the program; instead, all teens would be referred to as PEERS group members. Clinicians facilitated interactions between, and ensured equal participation in group discussions from, participants with and without ASD. Groups for behavioral rehearsals and dyads for homework assignments (e.g., making a phone call to a peer in the PEERS program) included at least one TD peer mentor. Other than the inclusion strategies discussed above, PwP did not differ in content from Traditional PEERS. Participants in all PEERS groups were asked to follow the rules outlined in the PEERS manual (Laugeson and Frankel 2010) regarding socialization outside of the intervention. Specifically, participants with ASD and TD peer mentors were told not to socialize with other PEERS participants outside of the weekly meetings during the 14-week intervention period.

Delayed Treatment Control. The DTC group did not receive intervention through the study until after time 3 data collection, at which point they completed Traditional PEERS. Parents were instructed to continue with treatment as usual during the wait period.

Measures

Parent-Report

Social Responsiveness Scale, Second Edition (SRS-2; Constantino and Gruber 2012). The SRS-2 is a widely used standardized measure of ASD symptoms. It has excellent internal consistency for both affected and unaffected adolescents ($\alpha = .94-.98$). Additional psychometric information is reported in the SRS-2 manual. The current study examined SRS-2 Total *T*-scores, which have a mean of 50 and a standard deviation of 10. Higher scores indicate more severe autism symptoms. Scores of 59 and below are considered to be “within normal limits” and are not generally indicative of ASD, whereas scores of 60 or above are considered to be consistent with clinically significant symptoms associated with ASD.

Social Skills Improvement System (SSIS; Gresham and Elliot 2008). The SSIS is a standardized measure of social skills and problem behaviors. For individuals ages 13–18 years, the parent-report SSIS has excellent internal consistency ($\alpha = .93-.96$). Additional psychometric information is reported in the SSIS manual (Gresham and Elliot 2008). Standard scores for the Social Skills and Problem Behaviors scales have means of 100 and standard deviations of 15. For the Social Skills scale, higher scores are associated with better social skills. For the Problem Behaviors Scale, higher scores are associated with having more problem behaviors.

Hosted and Invited Get-Togethers The parent version of the *Quality of Socialization Questionnaire (QSQ-P;* Frankel and Mintz 2008) was used to measure the number of hosted and invited get-togethers each adolescent participated in the previous month. Each parent completed the QSQ-P by indicating the number of get-togethers his or her teen hosted in the last month and the number of get-togethers his or her teen was invited to in the last month.

Adolescent-Report

Test of Adolescent Social Skills (TASSK; Laugeson and Frankel 2010). The TASSK is a 26-item measure developed by the authors of PEERS to assess understanding of information taught during the intervention. The TASSK has been used in all previous studies of the PEERS curriculum. Respondents choose one of two possible answers for each question. Higher scores indicate better social skills understanding.

Social Interaction Anxiety Scale (SIAS; Mattick and Clarke 1998). The SIAS is a measure of social anxiety that has been included in one previous examination of PEERS (Schohl et al. 2013). Example items include “I have difficulty making eye contact with others,” and “I am unsure whether to greet someone I know only slightly.”

Responses range from “Not at all—0” to “Extremely—4.” Total scores range from 0 to 76, with higher scores indicating higher social anxiety. The SIAS has good to excellent internal consistency depending on the sample (Cronbach’s $\alpha = 0.88\text{--}0.94$) and strong test–retest reliability ($r = .92$; Mattick and Clarke 1998).

Revised UCLA Loneliness Scale (R-UCLA; Russell et al. 1980). The R-UCLA measures loneliness. Example items include “I feel isolated from others,” and “There are people I feel close to.” Respondents indicate how often they feel the way described in each item ranging from “Never—1” to “Often—4.” Total scores range from 20 to 80, with higher scores indicating higher levels of loneliness. The authors report that the R-UCLA has excellent internal consistency (Cronbach’s $\alpha = .94$). Concurrent validity is supported by significant correlations with the Beck Depression Inventory ($r = .62$) and the Costello-Comrey Anxiety ($r = .32$) and Depression ($r = .55$) scales, and discriminant validity is supported by a lack of association with non-related constructs like feeling creative or surprised (Russell et al. 1980).

Hosted and Invited Get-Togethers The adolescent version of the *Quality of Socialization Questionnaire* (QSQ-A; Frankel and Mintz 2008) was used to measure the number of hosted and invited get-togethers each adolescent participated in the previous month.

Social Distance Scale (Gillespie-Lynch et al. 2015). An adapted version of the Social Distance Scale (Bogardus 1933) was administered to TD peer mentors. The 6-item scale measures stigma toward individuals with ASD using questions like, “How willing would you be to move next door to someone with autism” and “How willing would you be to start a collaborative project with someone with autism.” Participants responded to each question using a scale ranging from “1-Definitely willing” to “4-Unwilling”. Total scores range from 6 to 24, with higher scores indicating higher stigma. The scale has good internal consistency (Cronbach’s $\alpha = .87$; Gillespie-Lynch et al. 2015).

Autism Knowledge Questionnaire (AKQ; Kuhn and Carter 2006). An adapted version of the AKQ reflecting recent prevalence estimates and terminology was administered to TD peer mentors. Example items include “There is currently no medical test to diagnose autism,” and “There are only minor differences between children with autism and children with intellectual disabilities.” Participants responded by choosing “True,” “False,” or “Don’t know.” Participants received a score of 1 for every correct response, and a score of 0 for every incorrect or “Don’t know” response. Total scores ranged from 0 to 41, with higher scores indicating greater autism knowledge. The AKQ has good internal consistency ($\alpha = .79$; Kuhn and Carter 2006).

Data Management and Analysis

The father of one Traditional PEERS participant completed the time 1 SRS and SSIS; however, the participant’s mother subsequently attended the intervention and completed questionnaires at the remaining time points. This participant’s change scores were extreme outliers, which may reflect a lack of inter-rater reliability. Thus, these data points were treated as missing. One DTC participant was missing SSIS Social Skills responses at Time 3. Rather than omitting these participants from analyses and reducing statistical power, group mean substitution was used to manage missing data (Tabachnick and Fidell 1996), which represented less than 3–6% of records for each variable.

Primary data analysis included a total of four separate MANOVAs to examine the effect of study group on change in outcome variables from time 1 (pre-test) to time 2 (post-test) and from time 1 (pre-test) to time 3 (4-month follow-up). Outcome variables were split into two groups so as to not overload MANOVA models. The first set of variables included the SRS-2, SSIS Social Skills, SSIS Problem Behaviors, TASSK, SIAS, and R-UCLA. Two separate MANOVAs examined the effect of study group on time 1 to time 2 change and time 1 to time 3 change in these variables. The second set of variables included parent- and teen-reported hosted (QSQ-P hosted; QSQ-A hosted) and invited (QSQ-P invited; QSQ-A invited) get-togethers. Two separate MANOVAs examined the effect of time 1 to time 2 change and time 1 to time 3 change in these variables. Follow-up one-way ANOVAs with Bonferroni corrections were conducted for each outcome variable in significant MANOVA models.

Data screening indicated violations of assumptions of normality (R-UCLA time 1 to time 2; SIAS time 1 to time 3; all but two QSQ-P and QSQ-A change scores) and equality of variances (SSIS Social Skills time 1 to time 2; SIAS time 1 to time 3). Results of non-parametric Kruskal–Wallis tests were compared to results of parametric MANOVAs and ANOVAs, and did not differ substantively. For parsimony, MANOVA results are reported and differences in significance levels are reported in a footnote. Two extreme outliers were detected for R-UCLA time 1 to time 2, and four extreme outliers were detected for parent-reported hosted get-togethers from time 1 to time 3. Follow-up ANOVAs were run with and without extreme outliers.

Analyses for the second aim included separate paired samples *t* tests or Wilcoxon signed rank tests to examine change in each variable from time 1 to time 2 in TD peer mentors. A Bonferroni-corrected alpha of .004 (.05/12) was used. One extreme outlier was observed on the SIAS and AKQ. Analyses were run with and without the extreme outlier for these variables.

Table 3 Time 1 scores, change scores, and effect sizes for outcome measures in adolescents with ASD

	Traditional PEERS (<i>n</i> = 10) <i>M</i> (<i>SD</i>)	PEERS with Peers (<i>n</i> = 12) <i>M</i> (<i>SD</i>)	DTC (<i>n</i> = 12) <i>M</i> (<i>SD</i>)	Traditional PEERS v. DTC Cohen's <i>d</i> (size)	PEERS with Peers v. DTC Cohen's <i>d</i> (size)	Traditional PEERS v. PEERS with Peers Cohen's <i>d</i> (size)
SRS time 1	74.30 (6.52)	80.58 (8.83)	77.58 (12.10)			
Change T1–T2	7.67 (8.42)	7.92 (8.06)	3.00 (4.92)	0.68 (medium)	0.74 (medium)	0.03 (negligible)
Change T1–T3 [†]	5.89 (9.12)	9.25 (8.31)	2.08 (4.83)	0.52 (medium)	1.05 (large) [†]	0.39 (small)
SSIS Social Skills time 1	86.90 (7.84)	78.92 (8.78)	87.58 (11.08)			
Change T1–T2**	4.44 (7.86)	10.33 (10.55)	– 1.42 (3.82)	0.95 (large)	1.48** (large)	0.63 (medium)
Change T1–T3**	5.89 (5.55)	9.50 (10.51)	– 1.46 (4.51)	1.45 (large) [†]	1.35** (large)	0.43 (small)
SSIS Problem Behaviors time 1	114.20 (11.32)	122.58 (19.89)	115.42 (11.77)			
Change T1–T2*	5.22 (7.55)	9.08 (7.44)	1.58 (6.46)	0.52 (medium)	1.08* (large)	0.52 (medium)
Change T1–T3*	6.44 (7.72)	9.08 (7.65)	0.00 (6.63)	0.90 (large)	1.27** (large)	0.34 (small)
TASSK time 1	13.80 (2.35)	13.17 (2.86)	14.17 (2.92)			
Change T1– T2***	9.10 (2.77)	10.92 (3.09)	– 1.00 (2.30)	3.97 (large)***	4.38 (large)***	0.62 (medium)
Change T1– T3***	8.10 (3.18)	9.75 (2.73)	0.00 (1.76)	3.15 (large)***	4.24 (large)***	0.56 (medium)
SIAS time 1	22.20 (12.31)	34.25 (13.99)	25.67 (6.26)			
Change T1–T2	3.60 (10.30)	5.67 (12.83)	3.75 (8.23)	0.02 (negligible)	0.18 (negligible)	0.18 (negligible)
Change T1–T3	7.30 (8.88)	9.50 (18.01)	0.83 (7.31)	0.80 (large)	0.63 (medium)	0.16 (negligible)
R-UCLA time 1	40.50 (7.88)	42.75 (12.97)	39.67 (11.65)			
Change T1–T2	4.80 (5.25)	2.08 (14.73)	– 1.42 (6.22)	1.08 (large)	0.31 (small)	0.25 (small)
Change T1–T3	7.10 (4.58)	3.08 (12.60)	4.00 (7.34)	0.51 (medium)	0.09 (negligible)	0.42 (small)
R-UCLA time 1 (extreme outliers excluded) ^a	40.22 (8.30)	43.91 (12.93)	39.67 (11.65)			
Change T1–T2**	6.00 (3.84)	5.82 (7.37)	– 1.42 (6.22)	1.43* (large)	1.06* (large)	0.03 (negligible)
Change T1–T3	7.22 (4.84)	5.90 (8.32)	4.00 (7.34)	0.52 (medium)	0.24 (small)	0.19 (negligible)

DTC delayed treatment control group, SRS Social Responsiveness Scale, SSIS Social Skills Improvement System, TASSK Test of Adolescent Social Skills, SIAS Social Interaction Anxiety Scale, R-UCLA Revised UCLA Loneliness Scale

^aExtreme outliers (*n* = 1 Traditional PEERS; *n* = 1 PEERS with peers) excluded

p* < .05; *p* < .01; ****p* < .001; [†]*p* < .10

Results

Participants with ASD

Time 1 to Time 2

There was a large and significant effect of study group on change in SRS Total *T*-scores, SSIS Social Skills and Problem Behavior subscale scores, TASSK scores, SIAS scores, and R-UCLA scores (Pillai's trace = 0.99; $F(12, 54) = 4.42, p < .001, \eta_p^2 = .50$). There was also a large and significant effect of study group on QSQ-P/A hosted and QSQ-P/A invited get-togethers [$F(8, 58) = 2.07, p = .05, \eta_p^2 = .22$]. Results of significant follow-up ANOVAs (with Bonferroni corrections) are reported below. Descriptive statistics and effect sizes for all variables are reported in Tables 3 and 4.

There was a large and significant effect of study group on SSIS Social Skills change scores from time 1 to time 2 [Pillai's trace = 0.44; $F(2, 31) = 6.61, p = .01, \eta_p^2 = .30$]. There were significantly higher change scores in the PwP group compared to the DTC group, and the effect size was large ($p = .003, d = 1.48$). There was a large and significant effect of study group on SSIS Problem Behaviors change scores from time 1 to time 2 [$F(2, 31) = 3.31, p = .05, \eta_p^2 = .18$]. Significantly higher change scores were observed in the PwP group compared to the DTC group and the effect size was large ($p = .05, d = 1.08$).

There was a large and significant effect of group on TASSK change scores from time 1 to time 2 [$F(2, 31) = 65.07, p < .001, \eta_p^2 = .81$]. Traditional PEERS and PwP groups each had significantly higher TASSK change scores than the DTC group ($ps < .001$) indicating greater improvements in social skills knowledge relative to the DTC group;

Table 4 Time 1, change scores, and effect sizes for parent- and adolescent-reported get-togethers in adolescents with ASD

	Traditional PEERS (<i>n</i> = 10) <i>M</i> (<i>SD</i>)	PEERS with peers (<i>n</i> = 12) <i>M</i> (<i>SD</i>)	DTC (<i>n</i> = 12) <i>M</i> (<i>SD</i>)	Traditional PEERS v. DTC Cohen's <i>d</i> (size)	PEERS with Peers v. DTC Cohen's <i>d</i> (size)	Traditional v. PEERS with peers Cohen's <i>d</i> (size)
QSQ-P hosted time 1	0.10 (0.32)	0.92 (1.51)	0.67 (0.89)			
Change T1–T2*	1.70 (1.16)	1.50 (1.83)	0.25 (1.06)	1.31 (large) [†]	0.84 (large)	0.13 (negligible)
Change T1–T3	0.30 (1.06)	0.08 (1.17)	0.00 (1.41)	0.24 (small)	0.06 (negligible)	0.20 (small)
QSQ-P hosted time 1 (Extreme outliers excluded) ^a	0.00 (0.00)	0.92 (1.51)	0.64 (0.92)			
Change T1–T2*	2.00 (1.29)	1.50 (1.83)	0.09 (0.94)	1.69 (large)*	0.97 (large) [†]	0.32 (small)
Change T1–T3	0.00 (0.00)	0.08 (1.17)	−0.37 (0.67)	0.79 (medium)	0.47 (small)	0.10 (negligible)
QSQ-A hosted time 1	0.10 (0.32)	0.75 (1.36)	1.08 (1.73)			
Change T1–T2**	2.20 (2.39)	1.17 (1.70)	−0.42 (1.56)	1.30 (large)**	0.98 (large)	0.50 (medium)
Change T1–T3*	0.90 (1.29)	0.00 (1.28)	−0.75 (1.36)	1.25 (large)*	0.57 (medium)	0.70 (medium)
QSQ-P invited time 1	0.30 (0.68)	1.00 (1.48)	0.50 (0.67)			
Change T1–T2	0.70 (1.64)	−0.08 (0.90)	0.17 (1.47)	0.34 (small)	0.21 (small)	0.59 (medium)
Change T1–T3	0.10 (0.88)	0.00 (1.28)	0.42 (1.51)	0.25 (small)	0.30 (small)	0.09 (negligible)
QSQ-P invited time 1 (extreme outliers excluded) ^b	0.30 (0.68)	1.00 (1.48)	0.55 (0.69)			
Change T1–T2	0.70 (1.64)	−0.08 (0.90)	−0.18 (0.87)	0.67 (medium)	0.11 (negligible)	0.59 (medium)
Change T1–T3	0.10 (0.88)	0.00 (1.28)	0.09 (1.05)	0.01 (negligible)	0.08 (negligible)	0.09 (negligible)
QSQ-A invited time 1	0.30 (0.68)	1.33 (2.77)	0.25 (0.62)			
Change T1–T2	0.70 (1.95)	−0.58 (1.56)	0.08 (1.00)	0.40 (small)	0.50 (medium)	0.72 (medium)
Change T1–T3	0.80 (1.23)	0.00 (0.85)	0.25 (1.06)	0.48 (small)	0.26 (small)	0.76 (medium)
QSQ-A invited time 1 (extreme outliers excluded) ^c	0.30 (0.68)	0.55 (0.52)	0.09 (0.30)			
Change T1–T2	0.70 (1.95)	−0.18 (0.75)	0.28 (0.79)	0.28 (small)	0.60 (medium)	0.60 (medium)
Change T1–T3	0.80 (1.23)	0.18 (0.60)	0.46 (0.82)	0.33 (small)	0.39 (small)	0.64 (medium)

DTC delayed treatment control group, QSQ-PIA Quality of Socialization Questionnaire–Parent/Adolescent

^aExtreme outliers (*n* = 1 DTC; *n* = 3 Traditional PEERS) excluded

^bExtreme outlier (*n* = 1 DTC) excluded

^cExtreme outliers (*n* = 1 DTC; *n* = 1 PEERS with peers) excluded

p* < .05; *p* < .01; [†]*p* < .10

these were both large effects (Traditional PEERS *d* = 3.97; PEERS with Peers *d* = 4.38).

There was a medium non-significant effect of group R-UCLA changes scores from time 1 to time 2 [$F(2, 31) = 1.09, p = .35, \eta_p^2 = .07$].¹ The ANOVA was rerun excluding two extreme outliers (*n* = 1 Traditional PEERS; *n* = 1 PEERS with Peers). Without the outliers, there was a large significant main effect of group [$F(2, 29) = 5.36, p = .01, \eta_p^2 = .27$]. There were significantly higher change scores in the Traditional PEERS group compared to the DTC group ($p = .03, d = 1.43$) and in the PwP group compared

to the DTC group ($p = .03, d = 1.06$). Cohen's *d* statistics indicated these effects to be large.

There was a large and significant effect of group on change in parent-reported hosted get-togethers from time 1 to time 2 [$F(2, 31) = 3.58, p = .04, \eta_p^2 = .19$]. The Traditional PEERS group had marginally higher change scores compared to the DTC group, and the effect size was large ($p = .07, d = 1.31$). There was a large and significant effect of study group on change in adolescent-reported hosted get-togethers from time 1 to time 2 [$F(2, 31) = 5.42, p = .01, \eta_p^2 = .26$]. The Traditional PEERS group reported significantly greater increases in hosted get-togethers than the DTC group, and the effect size was large ($p = .01, d = 1.30$).

¹ A non-parametric Kruskal–Wallis test indicated a marginally significant effect of study group on R-UCLA changes scores from time 1 to time 2 [$H(2) = 5.38, p = .07$].

Time 1 to Time 3

There was a large and significant effect of study group on change in SRS Total T -scores, SSIS Social Skills and Problem Behavior subscale scores, TASSK scores, SIAS scores, and UCLA-R scores from time 1 to time 3 [Pillai's Trace = 0.87, $F(12, 54) = 3.46$, $p = .001$, $\eta_p^2 = .44$]. Results of significant follow-up ANOVAS (with Bonferroni corrections) are reported below. There was not a significant effect of study group on QSQ-P hosted, QSQ-P invited, QSQ-A hosted, and QSQ-P invited get-togethers from time 1 to time 3; however, the effect size was large [Pillai's Trace = 0.33, $F(8, 58) = 1.44$, $p = .20$, $\eta_p^2 = .17$]. Effect sizes and significance levels for between group comparisons on individual variables are reported in Tables 3 and 4.

There was a large effect of study group on SRS change scores from time 1 to time 3 that was approaching statistical significance [$F(2, 31) = 2.71$, $p = .08$, $\eta_p^2 = .15$]. There was a large difference between the PwP and DTC groups that was approaching statistical significance ($p = .08$, $d = 1.05$). There was a large and significant effect of study group on SSIS Social Skills change scores from time 1 to time 3 [$F(2, 31) = 6.72$, $p = .004$, $\eta_p^2 = .30$]. There were marginally higher change scores in the Traditional PEERS group ($p = .08$, $d = 1.45$) and significantly higher change scores in the PwP group ($p = .003$, $d = 1.35$) compared to DTC; Cohen's d indicated that both effects were large. There was also a large and significant effect of study group on SSIS Problem Behaviors change scores from time 1 to time 3 [$F(2, 31) = 4.85$, $p = .02$, $\eta_p^2 = .24$]. The PwP group had significantly higher change scores than the DTC group and Cohen's d indicated that this was a large effect ($p = .01$, $d = 1.27$).

There was a large and significant effect of group on TASSK change scores from time 1 to time 3 [$F(2, 31) = 48.17$, $p < .001$, $\eta_p^2 = .76$]. Both PEERS groups had significantly higher scores than DTC ($ps < .001$) and these were both large effects (Traditional PEERS $d = 3.15$; PEERS with Peers $d = 4.24$).

Post-hoc Analyses

To further explore the unexpected non-significant between group differences in SRS change scores, separate paired samples t tests were conducted for each study group using a Bonferroni corrected alpha of .008 (.05/6). Differences in SRS scores from time 1 to time 2 and time 1 to time 3 were not significant in the Traditional PEERS or DTC groups. There were significant reductions in SRS scores from time 1 to time 2 [$t(11) = 3.40$, $p = .006$] and time 1 to time 3 [$t(11) = 3.85$, $p = .003$] in the PwP group.

Despite significant differences between change in adolescent-reported hosted get-togethers, there were no significant differences between Traditional PEERS and PwP groups

in actual number of adolescent- or parent-reported hosted get-togethers at the initial or 4-month follow ups (Initial: Adolescent report $z = -0.27$, $p = .79$; Parent report $z = 0.98$, $p = .33$; 4-month: Adolescent report $z = -0.67$, $p = .50$; Parent report $z = 1.64$, $p = .10$).

Typically Developing Peer Mentors

There was a large and significant increase in social skills knowledge from time 1 to time 2 among the TD peer mentors ($z = 3.52$, $p < .001$, $d = 2.33$). There was also a medium reduction in adolescent-reported loneliness that was approaching statistical significance [$t(15) = 2.76$, $p = .01$, $d = 0.69$] a medium increase in autism knowledge that was approaching statistical significance ($t(14) = -2.48$, $p = .03$, $d = 0.66$),² and a medium increase in parent-reported invited get-togethers that was approaching statistical significance ($z = 1.98$, $p = .05$, $d = 0.57$). Descriptive statistics and effect sizes for all pre-post comparisons are reported in Table 2.

Discussion

The current study examined the effectiveness and feasibility of a peer-mediated PEERS curriculum by comparing immediate and 4-month outcomes of adolescents with ASD who completed the Traditional PEERS program, PwP, and a DTC group. Participants with ASD in the Traditional PEERS and PwP groups demonstrated significantly greater improvements in social skills knowledge and loneliness compared to the DTC group. Only the PwP group demonstrated significantly greater improvements in parent-reported social skills and problem behaviors compared to the DTC group, whereas only the Traditional PEERS group demonstrated significant gains in get-togethers compared to the DTC group. Many gains were maintained at the 4-month follow-up. TD peer mentors demonstrated significant or marginal increases in social skills knowledge, parent-reported get-togethers, and autism knowledge, as well as a marginal decrease in adolescent-reported loneliness. Together, findings indicate modest benefits of a peer-mediated PEERS curriculum for adolescents with ASD and peer mentors.

² When the extreme outlier was included, there was not a significant increase in autism knowledge [$t(15) = -0.83$, $p = .42$, $d = 0.21$]. This participant demonstrated a change score of -10 on the AKQ; the next lowest change score was -3 . The clinicians reported that this teen arrived late to the final session and seemed to be rushing to complete the post assessments.

Participants with ASD

Consistent with previous research, both treatment groups demonstrated significant gains in social skills knowledge compared to the DTC group that remained significant at the 4-month follow-up. Although not statistically significant, there were medium differences between the Traditional PEERS and PwP groups favoring the latter at both the immediate and 4-month follow-ups. Group means indicate that differences translate to almost two additional correct questions (T1–T2: 1.82; T1–T3: 1.65) on the TASSK (Laugeson and Frankel 2010), the 26-item test that assesses knowledge of social skills rules taught during PEERS. The PwP group demonstrated an increase of almost 11 points at the initial follow-up. To our knowledge, this is the greatest average increase among published studies of the PEERS curriculum (increases ranged from 6.3 to 9.2 points; Hill et al. 2017; Laugeson et al. 2009, 2012; Schohl et al. 2013; Van Hecke et al. 2015; Yoo et al. 2014). If replicated, these findings could indicate that peer-mediated PEERS is associated with improved comprehension of intervention content.

Inconsistent with most previous research, neither treatment group demonstrated statistically significant decreases in parent-reported autism symptoms compared to the DTC group. However, medium differences favoring the treatment groups were observed between each group and the DTC group at the immediate follow-up. At the 4-month follow-up, medium and large differences were observed favoring the treatment groups relative to the DTC group in the Traditional PEERS and PwP groups, respectively. The lack of statistically significant findings is surprising in the context of previous research that has shown reductions in SRS scores ranging from 10 to 23 points among PEERS treatment groups (Hill et al. 2017; Laugeson et al. 2012; Schohl et al. 2013; Van Hecke et al. 2015); reductions in the current study ranged from 5 to 9 points depending on study group and time point. Post-hoc within group paired *t* tests indicated a significant decrease in SRS scores at the initial and 4-month follow-ups in the PwP group, but not the Traditional PEERS group. The DTC group showed small, non-significant decreases at each time point, which contributed to the non-significant between group comparisons. Notably, one previous RCT of the Korean version of the PEERS program also did not demonstrate significant reductions in SRS scores (Yoo et al. 2014).

Some of the inconsistency compared to previous research may be due to differences in initial SRS scores. The treatment groups' initial scores in the current study were 20–28 points lower (i.e., less severe symptoms) than those reported by Schohl et al. (2013) and Van Hecke et al. (2015), suggesting either vast differences in symptom severity or in the parent report thereof. However, initial scores in the current study were consistent with other studies of the PEERS

program (Laugeson et al. 2012; Hill et al. 2017; Yoo et al. 2017), so this cannot be the only explanation for observed discrepancies in change in autism symptoms.

Participant age may have contributed to inconsistency with previous findings. Whereas previous studies included middle school and high school students (i.e., ages 11–17 years) (Laugeson et al. 2009, 2012; Schohl et al. 2013; Van Hecke et al. 2015), only high school students (i.e., ages 13–17 years) were enrolled in the current study. This resulted in a slightly older average age in the current sample. Longitudinal research suggests considerable improvement in the autism behavioral phenotype during the high school years for individuals without intellectual disability, followed by a slowing of improvement at high school exit (Lounds and Seltzer 2010). It is possible that change in autism symptoms during the PEERS intervention is less pronounced in older adolescents because they have already demonstrated improvement in autism symptoms with age. To our knowledge, previous studies have not examined age differences in treatment response to the PEERS curriculum. To explore this possibility with the current data, post-hoc correlations were conducted and revealed non-significant negative associations between participant age and SRS change scores ($r_s = -0.10$ to -0.30). This could be indicative of a small effect of age on change in SRS scores, but future studies utilizing a wider age range are necessary to fully examine this possibility.

It is also possible that the lack of significant reductions in SRS scores is attributable to the community-based setting, which differed from previous studies conducted in university settings. Differences could be due to variability in experience, knowledge, and/or motivation of clinicians, and/or the participants may have differed on one or more unmeasured variables. For example, many participants in the current sample were involved in ABA-based treatment at the autism center prior to participating in the study. It could be the case that participants in the current study differed from previous studies in amount and/or quality of previous intervention, which subsequently impacted their treatment response to PEERS. Also, familiarity with the autism center may have predisposed participants to have different expectations regarding the treatment relative to participants recruited to participate in a study at a university. These interpretations are speculative, as specific data regarding these variables were not collected in the current study, nor were they reported in previous studies. Importantly, both treatment groups in the current study demonstrated improvements in other areas functioning. Thus, the lack of significant change in SRS scores does not indicate that PEERS is ineffective in a community-based setting.

The SRS is an assessment of symptoms specifically related to ASD, whereas the SSIS measures the more general constructs of social skills and problem behaviors. Some

previous studies of the PEERS curriculum have reported significant improvements in social skills as measured by the SSIS or its predecessor, the SSRS (Laugeson et al. 2009, 2012), whereas others have not (Schohl et al. 2013; Hill et al. 2017). In the current study, participants in the PwP group demonstrated significant increases in parent-reported social skills relative to the DTC group that were maintained at the 4-month follow-up. Although not statistically significant, the differences between change scores in the Traditional PEERS and DTC groups were large. The increase from time 1 to the 4-month follow-up was greater than that from time 1 to the initial follow-up, which suggests that participants in the Traditional PEERS group continued to gain social skills after completing the intervention. Although not directly measured, it is possible that participants continued implementation of the social rules taught during PEERS (e.g., trading information, entering and exiting conversations, good sportsmanship, etc.) after termination of the intervention allowed for further development of social skills measured by the SSIS.

Previous findings regarding change in problem behaviors are mixed, with one study reporting no reduction (Laugeson et al. 2009), one indicating a significant decrease upon PEERS completion relative to a control group (Schohl et al. 2013), and one indicating a significant decrease relative to pre-PEERS scores at a 3-month follow-up, but not immediately after PEERS (Laugeson et al. 2012). In the current study, the PwP group demonstrated a significant decrease in problem behaviors relative to the DTC group that was maintained at the 4-month follow-up. Although not significant, differences in change scores between the Traditional PEERS and DTC groups were medium and large at the initial and 4-month follow-ups, respectively.

Findings discussed thus far suggest a modest advantage for the PwP group relative to Traditional PEERS. In contrast, findings regarding change in adolescent-reported get-togethers suggest a modest advantage for adolescents in the Traditional PEERS group who reported significantly greater increases in hosted get-togethers relative to the DTC group at the initial and 4-month follow-ups. Although not statistically significant, the differences between the PwP and DTC groups were large and medium at the initial and 4-month follow-up, respectively. Change in parent-reported get-togethers from time 1 to the initial follow-up were consistent with these patterns, but failed to achieve statistical significance. At the 4-month follow-up, parent report indicated that gains in hosted get-togethers were not maintained in either treatment group.

Notably, the actual number of parent- and teen-reported hosted get-togethers at the initial and 4-month follow-ups (as opposed to change from time 1) did not differ significantly between the two treatment groups; in fact, the PwP group had more parent-reported hosted get-togethers than the

Traditional PEERS group at the initial and 4-month follow-ups. It appears that some of the between group variance in change scores could be due to the PwP group having had more get-togethers at time 1 (although groups did not differ significantly). This is relevant when considered in the context of the homework assignments prescribed by the PEERS curriculum. Participants are taught to arrange one appropriate get-together each week (i.e., four get-togethers per month). Adolescents who are already having get-togethers at baseline ultimately need to demonstrate less improvement to reach the suggested number of monthly get-togethers outlined by the intervention. Thus, total number of get-togethers may be a more appropriate measure of outcome given the objectives of the intervention.

Another aim of the current study was to extend understanding of potential collateral effects of the PEERS curriculum on adolescent well-being. Inconsistent with previous research (Schohl et al. 2013), neither treatment group demonstrated significant reductions of social anxiety relative to the DTC group. However, at the 4-month follow-up, effect sizes for comparisons in change scores relative to the DTC group were large and medium in the Traditional PEERS and PwP groups, respectively. Additionally, average change scores were consistent with (Traditional PEERS: 7.30) or greater than (PEERS with Peers: 9.50) reductions reported by Schohl et al. (2013; average reduction: 7.56). Thus, it is possible that the PEERS curriculum contributed to a slow reduction in social anxiety. Additional research with a larger sample is warranted to further examine this possibility.

With one extreme outlier in each treatment group excluded, there were significantly greater reductions in adolescent-reported loneliness in the treatment groups relative to DTC at the immediate follow-up. Reductions were of similar magnitude in both treatment groups and were maintained at the 4-month follow-up. The lack of significant differences relative to the DTC group appears to be due to the DTC group demonstrating a small but notable decrease in loneliness at the 4-month follow-up. The two participants observed to be extreme outliers demonstrated large increases in loneliness relative to their fellow group members. It is unclear why their experiences differed from other participants. Feelings of loneliness can be transient or prolonged (Qualter et al. 2015); thus, it is possible that these participants were experiencing acute feelings of loneliness at the second time point. This appears to be the case for one of the participants, whose loneliness at the 4-month follow up was reported to be less than at entry into PEERS. It is also possible that these participants experienced increased insight into their limited social relationships because of their participation in PEERS, or that feelings of loneliness were associated with anticipation of treatment termination (Fortune et al. 1992). Future research with qualitative follow-up questions is necessary to better understand why a small

percentage of teens experienced an extreme increase (relative to other participants) in loneliness.

Taken together, the current findings provide additional evidence supporting the effectiveness of the PEERS curriculum and suggest the potential for a modest increase in effectiveness using a peer-mediated model. Although the two treatment groups did not differ significantly on any measure, the PwP group demonstrated more significant improvements relative to the DTC group, and effect sizes suggested medium differences between the treatment groups favoring PwP on some variables. Additional research with larger samples is necessary to determine whether the modest advantage associated with the peer-mediated model is replicable.

The findings reported here reflect administration of the PEERS curriculum in a community-based setting by practitioners who did not have current university affiliations and whose terminal degrees were less advanced than those in previously published research. It is promising that the current study replicated many findings from previous studies, which suggests that the PEERS curriculum is effective when implemented in a community-based setting. Importantly, the practitioners were supervised by certified providers who were trained at the UCLA PEERS Clinic, and fidelity checklists were completed and monitored throughout the study. It remains unclear whether similar findings would be observed without this supervision. Hill et al. (2017) recently reported results of a small ($n = 5$) pilot study of PEERS implemented in a community-based setting in which the clinicians were not certified PEERS providers. They observed improvements similar to those reported in RCTs of the program. Despite being implemented in a community-based setting, the program was administered by doctoral-level clinicians and one master's level clinician who was enrolled in a doctoral degree program. Together, the current findings and those of Hill et al. (2017) provide preliminary evidence that adolescents who complete PEERS in community-based settings demonstrate similar gains to those who complete the program in a university setting.

Typically Developing Peer Mentors

An exploratory aim was to examine potential effects of serving as a peer mentor in the PEERS curriculum. Previous research indicates that TD peer mentors in peer-mediated interventions can also show improvements in social outcomes (Owen-Deschryver et al. 2008). In the current study, TD peer mentors demonstrated improved social skills knowledge, marginal increases in parent-reported get-togethers, and marginal reductions in loneliness, which may indicate that serving as a peer mentor in the PEERS curriculum provides benefits to the TD participants.

Peer mentors also demonstrated marginal improvements in general autism knowledge, which is intriguing given that

the only direct instruction related to autism occurred at the 1-h peer mentor orientation. It is possible that exposure to adolescents with ASD resulted in implicit learning about the disorder and associated symptoms. It is also possible that TD peer mentors sought out additional information because of their involvement in the program. Research suggests that increased knowledge of autism is associated with reduced stigma (Gillespie-Lynch et al. 2015); thus, serving as a peer mentor could make TD adolescents more accepting of individuals with ASD. A reduction in stigma was not observed in the current study; however, this is likely attributable to considerably low stigma reported by peer mentors at study entry. Specifically, possible scores on the Social Distance Scale range from 6 to 24, and the average time 1 score was slightly lower than 8. Three of the peer mentors had siblings with ASD, and the majority of the remaining peer mentors had volunteered at the autism center in some capacity prior to serving as a peer mentor for the current study. The peer mentors' previous exposure to ASD could have contributed to their reports of low stigma; thus, this sample may be unrepresentative of the general population of potential TD peer mentors. This possibility is discussed in detail in the next section, as it is relevant to the feasibility of a peer-mediated model. Alternatively, peer mentors may have been demonstrating social desirability bias, or the tendency to respond in a manner that is perceived to be desirable by others. Despite being instructed to respond as honestly as possible and that their answers would be confidential, peer mentors completed the scale at the autism center and may have been concerned that the research staff and/or program facilitators would specifically attend to their responses.

Feasibility of Including Peer Mentors in PEERS

Recruitment of TD peer mentors did not pose a challenge, likely because the autism center regularly recruits TD volunteers for other intervention programs and has relationships with local high schools who refer students looking to satisfy volunteer requirements. Recruitment of TD peer mentors may serve as a challenge in other settings; however, it has been the autism center's experience that once local students are made aware of volunteer opportunities, there is a surplus of teens interested in volunteering. Findings from the current study regarding low baseline stigma among the TD peer mentors could indicate that they were more accepting of ASD than an average TD volunteer, and thus more willing to serve as a peer mentor. Future research is necessary to determine whether this is the case, and whether recruitment and participation of TD peers is feasible in other settings.

Peer mentors in the current study were likely motivated by remuneration for participation in the study. Although it is unclear whether TD participants would have participated without remuneration, the autism center regularly recruits

and retains TD peer mentors for similar-length interventions without monetary compensation.

Formal data were not collected on the conduct of the TD peer mentors during PEERS sessions; however, clinicians reported that the vast majority were able to implement peer mediation strategies with simple prompting from the clinicians. The most commonly reported challenge was the tendency of TD peer mentors to indicate that they did not complete homework assignments during homework review. Upon the first instance of this issue during the first cohort of the study, clinicians met with each TD mentor and encouraged them to be prepared with examples of how they completed each homework assignment, even if it was not explicitly for the purpose of the PEERS curriculum. This instruction was added to the orientation for the second cohort. Reminders were given on an individual basis as needed.

Overall, the inclusion of TD peer mentors in the PEERS program with only a 1-h orientation and ongoing prompting from clinicians was feasible. Anecdotally, clinicians reported that classroom management was easier during PwP sessions relative to Traditional PEERS sessions, and they perceived a reduced frequency of disruptive behaviors from each participant with ASD. Future research that specifically examines these variables may provide additional support for potential benefits of a peer-mediated PEERS model.

Limitations

The sample size was small resulting in inadequate statistical power to detect medium and small between group differences. However, the sample size reflects the preliminary nature of a pilot study and is consistent with early studies of the PEERS curriculum (Laugeson et al. 2009, 2012) and PEERS for Young Adults (Gantman et al. 2012). Participants were predominately Caucasian and from middle to upper-middle class families with well-educated parents; thus, the current findings may not generalize to more diverse populations. For example, economically disadvantaged families may experience more barriers to participating in an intervention that requires weekly attendance, considerable parental involvement, and enrollment in an extracurricular activity. Future research with larger sample sizes and increased racial, ethnic, and socioeconomic diversity is necessary to address these limitations. It was not possible to blind clinicians or participants to study group. Clinicians were instructed to be cognizant of implementing treatment to fidelity in every group, and fidelity checklists were maintained. Participants were not explicitly told whether they were assigned to Traditional PEERS or PwP, but all were informed of the purpose of the study during consent/assent procedures. It is likely that some parents, especially those in the PwP group, were aware of their group assignment through exposure (or lack of

exposure) to TD peer mentors. Future research could address this limitation through deception about the purpose of the study and subsequent debriefing at the end of the study.

The mechanism underlying differences in outcomes among adolescents who completed Traditional PEERS and PwP was not examined. Opportunities to practice social skills with a peer who does not have social communication impairments may be associated with improved outcomes. Alternatively, the classroom environment was likely qualitatively different between groups, given that PwP had approximately half the number of participants with ASD. A third possibility is that the parents of adolescents in the PwP group received more individualized coaching because there were half as many parents in each group. Efforts were made to reduce this possibility through fidelity checklists and by encouraging the clinician to administer the parent sessions uniformly across groups. The PwP parent sessions regularly ended earlier than the Traditional PEERS sessions, presumably because much of the parent group revolves around homework review, and fewer parents should translate to a shorter session. It is also possible that a smaller parent group is a disadvantage because the curriculum emphasizes the importance of teaching parents to brainstorm effective strategies with each other. A smaller group of parents may yield fewer ideas. Future research could examine these possibilities by matching the number of teens with ASD in each group, thus isolating the variable of interaction with TD peer mentors.

Most previous examinations of the PEERS curriculum have relied on parent and adolescent-report to measure outcomes, and have not used direct observation of behavioral change (Hood et al. 2017). Thus, most previous studies were vulnerable to placebo effects, since participants were not blinded to study group. The current findings are also limited by this possibility. However, this study is ongoing and includes objective measures, including the comparison of school social networks and structured conversation probes. Findings from these measures will be reported when data collection and coding are complete.

Conclusion

This preliminary examination demonstrated the feasibility of a peer-mediated PEERS model and suggested the potential for modest improvements in outcomes related to social skills knowledge, social skills, and problem behaviors in adolescents with ASD who completed the peer-mediated PEERS curriculum relative to adolescents who completed the traditional PEERS program. Both groups demonstrated improvements in social skills knowledge and decreases in loneliness related to the DTC group. Future research with a larger sample size and more objective outcome measures is needed to corroborate these findings.

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Author Contributions NM conceived the study design and oversaw all aspects of study implementation, including recruitment, screening, randomization, training and supervision of the clinical staff and research assistants, data collection, data cleaning, and statistical analysis. She also drafted the manuscript. BO managed and supervised the autism center's clinical staff and contributed to writing and revising the manuscript. KW, MD, and MS implemented the intervention, assisted with data collection, and reviewed the manuscript prior to submission. JL contributed to writing and revising the manuscript. CS collaborated on all aspects of the study, including study design, implementation, data analysis, and writing and revising the manuscript.

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Compliance with Ethical Standards

Conflict of interest Nicole L. Matthews, Beatriz C. Orr, Katrina Wariner, Mary DeCarlo, Mia Sorensen, Jessica Laffin and Christopher J. Smith declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Research Involving with Human and Animal Participants This study does not contain any studies with animals performed by any of the authors.

References

- American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th edn.). Arlington, VA: American Psychiatric.
- Bogardus, E. S. (1933). A social distance scale. *Sociology & Social Research*, 17, 265–271.
- Camarena, P. M., & Sarigiani, P. A. (2009). Postsecondary educational aspirations of high-functioning adolescents with autism spectrum disorders and their parents. *Focus on Autism and Other Developmental Disabilities*, 24, 115–128. <https://doi.org/10.1177/1088357609332675>.
- Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services. (2014). Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2010. *MMWR*, 63(2), 1–22.
- Chan, J. M., Lang, R., Rispoli, M., O'Reilly, M., Sigafos, J., & Cole, H. (2009). Use of peer-mediated interventions in the treatment of autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders*, 3(4), 876–889. <https://doi.org/10.1016/j.rasd.2009.04.003>.
- Christensen, D. L., Bilder, D. A., Zahorodny, W., Pettygrove, S., Durking, M., Fitzgerald, R. T., ... Yeargin-Allsopp, M. (2016). Prevalence and characteristics of autism spectrum disorder among 4-year-old children in the Autism and Developmental Disabilities Monitoring Network. *Journal of Developmental and Behavioral Pediatrics*, 37, 1–8. <https://doi.org/10.1097/DBP.0000000000000235>.
- Constantino, J. N., & Gruber, C. P. (2012). *Social Responsiveness Scale, Second Edition (SRS-2)*. Torrance, CA: Western Psychological Services.
- Dingfelder, H. E., & Mandell, D. S. (2011). Bridging the research-to-practice gap in autism intervention: An application of diffusion of innovation theory. *Journal of Autism and Developmental Disorders*, 41, 597–609. <https://doi.org/10.1007/s10803-010-1081-0>.
- Fortune, A. E., Pearlingi, B., & Rochelle, C. D. (1992). Reactions to termination of individual treatment. *Social Work*, 37, 171–178.
- Frankel, F., & Mintz, J. (2008). Measuring the quality of play dates. UCLA Parenting and Children's Friendship Program, 300 Medical Plaza, Los Angeles.
- Gantman, A., Kapp, S. K., Orenski, K., & Laugeson, E. A. (2012). Social skills training for young adults with high-functioning autism spectrum disorders: A randomized controlled pilot study. *Journal of Autism and Developmental Disorders*, 42, 1094–1103. <https://doi.org/10.1007/s10803-011-1350-6>.
- Gillespie-Lynch, K., Brooks, P. J., Someki, F., Obeid, R., Shane-Simpson, C., Kapp, S. K., ... Smith, D. S. (2015). Changing college students' conceptions of autism: An online training to increase knowledge and decrease stigma. *Journal of Autism and Developmental Disorders*, 45, 2553–2566. <https://doi.org/10.1007/s10803-015-2422-9>.
- Gresham, F. M., & Elliot, S. N. (2008). *Social Skills Improvement System: Rating Scales*. Bloomington, MN: Pearson Assessments.
- Grondhuis, S. N., & Aman, M. G. (2012). Assessment of anxiety in children and adolescents with autism spectrum disorders. *Research in Autism Spectrum Disorders*, 6(4), 1345–1365. <https://doi.org/10.1016/j.rasd.2012.04.006>.
- Hill, T. L., Gray, S. A. O., Baker, C. N., Boggs, K., Carey, E., Johnson, C., ... Enrique Varela, R. (2017). A pilot study examining the effectiveness of the PEERS program on social skills and anxiety in adolescents with autism spectrum disorder. *Journal of Developmental and Physical Disabilities*, 29, 797–808. <https://doi.org/10.1007/s10882-017-9557-x>.
- Hood, S. A., Luczynski, K. C., & Mitteer, D. R. (2017). Toward meaningful outcomes in teaching conversation and greeting skills with individuals with autism spectrum disorder. *Journal of Applied Behavior Analysis*, 50, 459–486. <https://doi.org/10.1002/jaba.388>.
- Kasari, C., Dean, M., Kretzman, M., Shih, W., Orlich, F., Whitney, R., ... King, B. (2016). Children with autism spectrum disorder and social skills groups at school: A randomized trial comparing intervention approach and peer composition. *The Journal of Child Psychology and Psychiatry*, 57, 171–179. <https://doi.org/10.1111/jcpp.12460>.
- Kasari, C., Rotheram-Fuller, E., Locke, J., & Gulsrud, A. (2012). Making the connection: Randomized control trial of social skills at school for children with autism spectrum disorders. *Journal of Child Psychology and Psychiatry*, 53, 431–439. <https://doi.org/10.1111/j.1469-7610.2011.02493.x>.
- Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman Brief Intelligence Test—Second Edition (KBIT-2) Manual*. Bloomington, MN: Pearson Assessments.
- Kuhn, J. C., & Carter, A. S. (2006). Maternal self-efficacy and associated parenting cognitions among mothers of children with autism.

- American Journal of Orthopsychiatry*, 76, 564–575. <https://doi.org/10.1037/0002-9432.76.4.564>.
- Lasgaard, M., Nielson, A., Eriksen, M., & Goossens, L. (2010). Loneliness and social support in adolescent boys with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 40(2), 218–226. <https://doi.org/10.1007/s10803-009-0851-z>.
- Laugeson, E. A., & Frankel, F. (Eds.). (2010). Test of Adolescent Social Skills Knowledge, Mental Status Checklist. In *The PEERS treatment manual*. New York: Routledge.
- Laugeson, E. A., Frankel, F., Gantman, A., Dillon, A. R., & Mogil, C. (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS Program. *Journal of Autism and Developmental Disorders*, 42, 1025–1036. <https://doi.org/10.1007/s10803-011-1339-1>.
- Laugeson, E. A., Frankel, F., Mogil, C., & Dillon, A. R. (2009). Parent-assisted social skills training to improve friendships in teens with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 39, 596–606. <https://doi.org/10.1007/s10803-008-0664-5>.
- Levy, A., & Perry, A. (2011). Outcomes in adolescents and adults with autism: A review of the literature. *Research in Autism Spectrum Disorders*, 5, 1271–1282. <https://doi.org/10.1016/j.rasd.2011.01.023>.
- Lord, C., Rutter, M., DiLavore, P. C., Risi, S., Gotham, K., & Bishop, S. L. (2012). *Autism diagnostic observation schedule, second edition (ADOS-2) manual (Part 1): Modules 1-4*. Torrance, CA: Western Psychological Services.
- Lord, C., Wagner, A., Rogers, S., Szatmari, P., Aman, M., Charman, T., et al. (2005). Challenges in evaluating psychosocial interventions for autistic spectrum disorders. *Journal of Autism and Developmental Disorders*, 30, 393–398. <https://doi.org/10.1007/s10803-005-0017-6>.
- Lounds, J. T., & Seltzer, M. M. (2010). Changes in the behavioral phenotype during the transition to adulthood. *Journal of Autism and Developmental Disorders*, 40, 1431–1446. <https://doi.org/10.1007/s10803-010-1005-z>.
- Mattick, R. P., & Clarke, J. C. (1998). Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. *Behaviour Research and Therapy*, 36, 455–470. [https://doi.org/10.1016/S0005-7967\(97\)10031-6](https://doi.org/10.1016/S0005-7967(97)10031-6).
- Odom, S. L., & Strain, P. S. (1984). Peer-mediated approaches to promoting children's social interaction: A review. *American Journal of Orthopsychiatry*, 54, 544–557. <https://doi.org/10.1111/j.1939-0025.1984.tb01525.x>.
- Owen-Deschryver, J. S., Carr, E. G., Cale, S.L., & Blakeley-Smith, A. (2008). Promoting social interactions between students with autism spectrum disorders and their peers in inclusive school settings. *Focus on Autism and Other Developmental Disabilities*, 23(1), 15–28. <https://doi.org/10.1177/1088357608314370>.
- Qualter, P., Vanhalst, J., Harris, R., Van Roekel, E., Lodder, G., Bagee, M. ... Verhagen, M. (2015). Loneliness across the lifespan. *Perspectives on Psychological Science*, 10, 250–264. <https://doi.org/10.1177/1745691615568999>.
- Russell, D., Peplau, L. A., & Cutrona, C. E. (1980). The Revised UCLA Loneliness Scale: Concurrent and discriminant validity analysis. *Journal of Personality and Social Psychology*, 39, 472–480.
- Schmidt, C., & Stichter, J. P. (2012). The use of peer-mediated interventions to promote the generalization of social competence for adolescents with high-functioning autism and Asperger's syndrome. *Exceptionality*, 20, 94–113. <https://doi.org/10.1080/09362835.2012.669303>.
- Schohl, K. A., Van Hecke, A., Carson, A. M., Dolan, B., Karst, J., & Stevens, S. (2013). A replication and extension of the PEERS intervention examining effects on social skills and social anxiety in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 44, 532–545. <https://doi.org/10.1007/s10803-013-1900-1>.
- Sparrow, S. S., Cicchetti, D. V., & Balla, D. A. (2005). *Vineland Adaptive Behavior Scales, Second Edition (Vineland II: Survey Forms Manual)*. Bloomington, MN: Pearson Assessments.
- Strang, J. F., Kenworthy, L., Daniolos, P., Case, L., Wills, M. C., Martin, A., & Wallace, G. L. (2012). Depression and anxiety symptoms in children and adolescents with autism spectrum disorders without intellectual disability. *Research in Autism Spectrum Disorders*, 6(1), 406–412. <https://doi.org/10.1016/j.rasd.2011.06.015>.
- Tabachnick, B. G., & Fidell, L. S. (1996). *Using Multivariate Statistics, Third Edition*. New York: HarperCollins College.
- Van Hecke, A., Stevens, S., Carson, A. M., Karst, J. S., Dolan, B., Schohl, K., ... Brockman, S. (2015). Measuring the plasticity of social approach: A randomized controlled trial of the effects of PEERS intervention on EEG asymmetry in adolescents with autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 45(2), 316–335. <https://doi.org/10.1007/s10803-013-1883-y>.
- Watkins, L., O'Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G. E., Sigafoos, J., & Lang, R. (2015). A review of peer-mediated social interaction interventions for students with autism in inclusive settings. *Journal of Autism and Developmental Disorders*, 45(4), 1070–1083. <https://doi.org/10.1007/s10803-014-2264-x>.
- Wood, J. J., & Gadow, K. D. (2010). Exploring the nature and function of anxiety in youth with autism spectrum disorders. *Clinical Psychology: Science and Practice*, 17(4), 281–292. <https://doi.org/10.1111/j.1468-2850.2010.01220.x>.
- Yoo, H., Bahn, G., Cho, I., Kim, E., Kim, J., Min, J., ... Laugeson, E. A. (2014). A randomized controlled trial of the Korean version of the PEERS Parent-Assisted Social Skills Training Program for Teens with ASD. *Autism Research*, 7(1), 145–161. <https://doi.org/10.1002/aur.1354>.