



# PEERS® for Preschoolers preliminary outcomes and predictors of treatment response

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## Abstract

PEERS® for Preschoolers (P4P) is a social skills group program for young autistic children and their caregivers, which provides everyday tools for interacting and communicating with others. Twenty-two caregiver-child dyads participated and completed pre-treatment, post-treatment, and follow-up measures (4–16 weeks after). Using single-subject analyses to examine social skills, 60% demonstrated post-treatment improvement, and 53.85% demonstrated follow-up improvement. Regarding a secondary outcome of behavioral difficulties, 33.33% demonstrated post-treatment reduction, and 7.69% demonstrated follow-up reduction. Using regressions, autistic traits predicted outcomes; fewer social communication difficulties predicted both greater social skills and fewer behavioral difficulties at post-treatment, while fewer repetitive behaviors predicted fewer post-treatment and follow-up behavioral difficulties. These results preliminarily demonstrate the benefits of P4P and how autistic traits may impact P4P outcomes.

**Keywords** autism spectrum disorder · social skills · PEERS · preschoolers · social outcomes · behavioral difficulties

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**Informed Consent:** Caregivers provided written consent and children provided verbal assent.

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## Introduction

Social skills, socially acceptable learned behaviors that allow for positive interactions (Gresham et al., 2011), are a common treatment target for autistic<sup>1</sup> individuals (Gates et al., 2017). Social differences are a fundamental aspect of autism spectrum disorder (ASD), with three primary

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<sup>1</sup> Based on work from Kenny et al., (2016) and Bottema-Beutel et al., (2020) we use identity-first language and have adjusted terminology to minimize potentially ableist terms. Potentially ableist terms (i.e., problem behaviors, autism symptoms) were minimally used and only to refer to the measure scales or diagnostic criteria.

areas: nonverbal communication (e.g., differences in eye contact), social-emotional reciprocity (e.g., reduced turn-taking in conversation), and development/maintenance of relationships (e.g., difficulties making friends; American Psychiatric Association, 2013). Variations in social communication are often evident in early development (Paul, 2003). The second diagnostic domain, restricted and repetitive behaviors (RRB; APA, 2013), has been linked to social communication differences, such as perseverating on topics of interest, as well as increased behavioral difficulties (Factor et al., 2016; Ray-Subramanian & Weismer, 2012). Although several treatment avenues exist for targeting social skills, few group-based didactic social skills interventions for young highly-verbal autistic children exist. Given that childhood is a critical period for social-emotional development (Nelson et al., 2019; Tottenham, 2017), and recent evidence suggesting that preschool-age may be a specific turning point for autism-related outcomes (e.g., autistic trait levels, language, cognitive, and adaptive skills; Georgiades et al., 2021), social skills group interventions may be particularly helpful at this age. Literature on caregiver influences on social-emotional development (Gee et al., 2014) suggests that a caregiver-mediated intervention may be especially beneficial. Moreover, targeting social skills at young ages may have positive short- and long-term effects on social functioning and well-being outcomes (Watkins et al., 2015). Thus, the present study aimed to examine child outcomes following a caregiver-mediated social skills group intervention for autistic children ages 4–7 years, Program for the Education and Enrichment of Relational Skills (PEERS®) for Preschoolers (P4P; Park, Moulton, & Laugeson, 2022). Further, considering the links between autistic traits and social and behavioral difficulties (i.e., externalizing, bullying, hyperactivity/inattention, and internalizing difficulties; Gresham & Elliot, 2008), and work elucidating positive secondary outcomes of PEERS® programs at older ages (Factor et al., 2022a; Hill et al., 2017; Mandelberg et al., 2014; Lordo et al., 2017; Schiltz et al., 2018; Schohl et al., 2014; Yoo et al., 2014), we aimed to examine the role of core autistic traits (as measured by the *Social Responsiveness Scale-2*; *SRS-2*; Constantino, 2013; Constantino & Gruber, 2005) as predictors of intervention outcomes.

The preschool years are crucial for shaping autism-relevant outcomes (Georgiades et al., 2021). Social skills group interventions delivered at this young age may ameliorate social and behavioral difficulties. Despite the importance of this developmental period, reviews of group-based social skills interventions for autistic children under the age of 6 years has been limited (Gates et al., 2017; Kaat & Lecavalier, 2014), in contrast to work on one-to-one interventions targeting social communication using applied behavior analysis techniques (Gunning et al., 2019). Of the

few social skills group interventions developed for young autistic children, existing literature has emphasized the importance of didactic training, behavioral approaches, and feedback (Leaf et al., 2017; Murdock et al., 2013; Radley et al., 2015). Few manualized social skills group interventions for young autistic children are currently available, and only a handful of group-based programs explicitly address the development of social skills as a *primary* intervention target (DeRosier et al., 2011; Lord et al., 2005; Reichow & Volkmar, 2010; White et al., 2007; Wolstencroft et al., 2018). Moreover, the benefit of caregiver-mediated interventions has been highlighted, as incorporating caregivers can aid in generalizability, maintenance of skills, and individual and caregiver/family outcomes (Factor et al., 2019; Klinger et al., 2013; Pacia et al., 2021; Trembath et al., 2019). However, despite this emergent work, patterns of and expectations for general outcomes for young autistic children following social skills group interventions remains largely unknown.

Two common outcome measures of social skills group interventions in autistic youth are the *Social Skills Improvement System (SSiS*; Gresham & Elliott, 2008; Gresham et al., 2011) and *Social Responsiveness Scale-2 (SRS-2*; Constantino, 2013; Constantino & Gruber, 2005). Wolstencroft and colleagues (2018) conducted a systematic review and meta-analysis of outcomes of group-based social skills interventions for autistic people (ages 6–25 years) and found moderate effects in social skills improvement, though not in behavioral difficulties (i.e., internalizing, externalizing, hyperactivity, bullying) as indicated by the *SSiS*. Additionally, these interventions had large effects in decreasing both RRB and social communication difficulties, as indicated by the *SRS-2* (Wolstencroft et al., 2018). This finding of reduction in RRB following social skills has been commonly found and considered a secondary effect of the intervention (Bauminger, 2002; Lee et al., 2007; Loftin et al., 2008). As Wolstencroft and colleagues (2018) included results from social skills group interventions for autistic people ages 6–25 years, it is important to examine whether these patterns in intervention outcomes generalize to younger autistic samples.

One of the only evidence-based caregiver-mediated social skills interventions for autistic adolescents and young adults is PEERS® and it has recently been adapted for younger children ages 4–7 years (Park et al., 2022). PEERS® uses a cognitive-behavioral approach to enhance social functioning and teaches ecologically valid skills which can be used to make and keep friends (Laugeson & Park, 2014). PEERS® includes a structured autistic client group, with a separate simultaneous caregiver group where caregivers discuss psychoeducation, social skills, and strategies for social coaching in everyday life. Multiple clinical and randomized

controlled trials (RCT) have demonstrated effectiveness with autistic adolescents (Laugeson et al., 2009, 2012; Van Hecke et al., 2013; Yoo et al., 2014) and young adults (Gantman et al., 2012; Laugeson et al., 2015), and maintenance of treatment gains one-to-five years following intervention (Mandelberg et al., 2014). Thus, the ecological validity has been supported in these previous studies. P4P highlights the same tenets of PEERS® for Adolescents and Young Adults but presents them in a more developmentally appropriate manner (i.e., using puppets, songs, and games to aid in social skill development). Further, while the caregiver training component continues to be emphasized in P4P, there is an added caregiver-coached play at the end of each session, which allows caregivers to engage in the skills taught and the opportunity to be coached by a clinician on their own social coaching skills. Initial P4P findings have suggested generally positive outcomes for both child and family/caregivers (Factor et al., 2022b, c; Park et al., 2022). Further, evidence suggests sustained long-term outcomes one-to-five years following P4P, especially in social domains (Tripathi et al., 2021). While results are promising, further research is needed on the efficacy of P4P. Although emerging work on P4P has primarily examined social skills and caregiver outcomes, no work to date has examined secondary effects (i.e., behavioral difficulties and RRB) and predictors of P4P outcomes.

There is also a need for theory-driven predictors of treatment outcomes for autistic people (Klinger et al., 2020; Vivanti et al., 2014). For example, evidence-based treatment decisions can be facilitated by identifying mechanistic pathways by which certain autistic traits may influence primary (i.e., social skills improvement) and secondary outcomes (i.e., reduction in behavioral difficulties). The social motivation hypothesis of autism provides a theoretical framework for linking social communication aspects of autism to social skills outcomes (Chevallier et al., 2012; Clements et al., 2018; Dichter, 2018), such that atypical early reciprocal social interactions (e.g., social smiling, eye contact, orienting) may have cascading effects on later social functioning (Farroni et al., 2002; Messinger et al., 2001). As autistic children age, social skills difficulties emerge, including difficulties in understanding social pragmatics, perseverative speech, and difficulties in emotion regulation, expression, and understanding (White et al., 2007). Moreover, autistic youth spend less time interacting with peers, have lower quality exchanges (Lord & McGill-Evans, 1995; Sigman & Ruskin, 1999), and report fewer friends and more loneliness compared to controls (Bauminger et al., 2003; Kasari et al., 2011). Lack of close reciprocal friendships can deprive autistic youth of the positive and protective effects of friendships on well-being (Chu et al., 2010; Schiltz et al., 2021). Thus, social skills, which facilitate opportunities for making

and keeping friends, may provide an avenue to buffer this effect. Further, understanding how core autistic traits impact intervention outcomes may aid in bolstering intervention effects.

Although the social motivation hypothesis was previously thought to be specific to diminished social interest, this lack of attention to social information and preference toward nonsocial information may have cascading effects on the emergence of RRB (Antezana et al., 2015; Sasson & Touchstone, 2014). For example, RRB, which spans stereotyped behavior, self-injurious behavior, insistence on sameness, restricted interests, and sensory difficulties, has been theorized to have underpinnings in cognitive inflexibility (Condy et al., 2019; Kenworthy et al., 2009; Scarpa et al., 2021). Difficulties in cognitive flexibility, which underlie RRB, may in part, impact various types of social skills (i.e., generalizability of social skills to new settings/people) and behavioral difficulties (e.g., anxiety, outbursts, oppositionality; Antezana et al., 2019; Hollocks et al., 2021). For example, a recent study uncovered that increased insistence on sameness, repetitive sensory-motor, and self-injurious behavior were each uniquely associated with diminished social skills in autistic toddlers (Chaxiong et al., 2021). Moreover, Neuhaus and colleagues (2019) found that greater self-injurious behavior impacted the relationship between diminished social motivation and diminished social skills. As such, the presence of these links between facets of RRB and social skills further supports their intertwined nature. RRB has also been found to impact several emotional and behavioral difficulties. Although certain facets of RRB (i.e., restricted interests, stereotyped behavior) bring value to autistic people's lives (Grove et al., 2018) and play a role in self-soothing (Gabriels et al., 2013; Kapp et al., 2019), very high levels of RRB have frequently been linked to diminished quality of life (de Vries & Geurts, 2015; Oakley et al., 2020; Steensel et al., 2012) and increased co-occurring psychiatric symptomatology, including anxiety and oppositionality (Duvekot et al., 2018; Stratis & Lecavalier, 2013). These findings are consistent with work indicating that high levels of insistence on sameness and self-injurious behavior are associated with greater internalizing difficulties (Factor et al., 2016; Gotham et al., 2013; Muskett et al., 2019; Russell et al., 2019; Uljarević et al., 2017) and that greater RRB has a strong association with emotion dysregulation (Samson et al., 2014). Moreover, recent longitudinal work in autistic children found that those with greater RRB were at risk for greater emotion dysregulation across time (Greenlee et al., 2021). Thus, RRB and social, emotional, and behavioral difficulties may be tightly intertwined for young autistic children, and social skills interventions at this age may have positive downstream effects.

**Table 1** Participant characteristics

Measure	<i>N</i>	Minimum	Maximum	<i>M</i>	<i>SD</i>
Caregiver Age (years)	22	27	42	36.13	5.14
Child Age at Intake (years)	22	3	7	4.95	1.05
ADOS-2 (comparison Score)	Mod 2 = 5 Mod 3 = 13	4	10	6.94	1.86
KBIT-2 IQ Composite	22	76	127	100.86	14.52

Building on this literature and using the *SSiS* and *SRS-2*, the present study aimed to (1) determine whether P4P produced improvement in social skills, and reduction in behavioral difficulties, social communication difficulties, and RRB, and (2) examine whether core autistic traits impacted improvement in social skills and reduction in behavioral difficulties at post-treatment and follow-up. Specifically, we planned to use an individual outcome approach (Jacobson & Truax, 1991), which has commonly been used in intervention research with autistic samples (Conner & White, 2018; Factor et al., 2022c; White et al., 2015, 2016), as it can aid in the understanding of heterogeneous outcomes and account for imprecise measurement. Further, considering the links between core autistic traits and social and behavioral difficulties, we hypothesized that fewer RRB would predict fewer behavioral difficulties (i.e., externalizing, bullying, hyperactivity/inattention, and internalizing difficulties, excluding RRB items) at post-treatment/follow-up, and that fewer social communication difficulties would predict greater social skills at post-treatment/follow-up.

## Method

### Participants

Participants were recruited via multiple methods (e.g., clinics, registries, schools, caregiver support groups, resource centers) from fall of 2017 through fall of 2019. Twenty-seven caregiver/child dyads enrolled in this study. Five dyads were excluded for reasons listed below. Thus, 22 caregiver/child dyads (13 boys; 77.3% White) completed P4P (>60% attendance) across six groups (three groups in Blacksburg, Virginia and three groups in Atlanta, Georgia). Children were 4–7 years ( $M=4.95$ ,  $SD=1.05$ ) at the start of treatment. Eligibility criteria for children included: (1) previous ASD diagnosis, confirmed by the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012), (2) an Intelligence Quotient (IQ)  $\geq 70$  on the Kaufman Brief Intelligence Test-2 (KBIT-2; Kaufman & Kaufman, 2004), (3) reported urinary continence, (4) ability to tolerate a group setting, which included playing games and singing songs, and (5) English fluency. Participants were excluded if there was presence of an active medical problem, psychiatric concerns, physical aggression, or if

**Table 2** Descriptive statistics

Variable	Percentage ( <i>n</i> )
<b>Child Sex</b>	
Male	59.1 (13)
Female	40.9 (9)
<b>Caregiver Sex (completed measures)</b>	
Male	36.4 (8)
Female	63.6 (14)
<b>Location</b>	
Blacksburg, Virginia	54.5 (12)
Atlanta, Georgia	45.5 (10)
<b>Child Ethnicity</b>	
Black	9.1 (2)
Asian	4.5 (1)
White	77.3 (17)
Mixed Race	4.5 (1)
Other	4.5 (1)
<b>Approximate Yearly Household Income</b>	
< \$10,000	4.5 (1)
\$10,000-\$25,000	9.1 (2)
\$25,000-\$50,000	4.5 (1)
\$50,000-\$75,000	9.1 (2)
\$75,000-\$100,000	9.1 (2)
\$100,000-\$200,000	22.7 (5)
\$200,000+	9.1 (2)
Did not report	31.8 (7)
<b>Highest Level of Schooling Completed by Caregiver</b>	
Graduated High School	13.6 (3)
Graduated Trade School	13.6 (3)
Associate's degree	4.5 (1)
Bachelors/4-year degree	13.6 (3)
Graduate School	36.4 (8)
Did not report	18.2 (4)

the child was unable to stay on current medication during treatment.

Five dyads were excluded from data analyses. One dyad was eligible but could not participate due to time commitment; three dyads dropped out of treatment due to: medication changes, psychiatric concerns, and child health difficulties. Thus, our attrition rate was 14.81% (4/27). Finally, the fifth dyad was excluded, as the dyad completed P4P due to general social skills difficulties, though the child did not meet ASD criteria. There were two drops in Virginia and two drops in Georgia. Participant characteristics and demographics are presented together as no differences were found across sites/groups (Tables 1 and 2).

## Procedure

Preliminary eligibility was assessed via phone screen with caregivers. At pre-treatment, caregivers provided written consent and children provided verbal assent. Pre-treatment assessment determined child eligibility, using the ADOS-2 and KBIT-2. These sessions lasted approximately one hour and 30min. Caregivers completed the SRS-2 (Constantino & Gruber, 2012) and SSiS (Gresham & Elliot, 2008) at pre-treatment, post-treatment, and at follow-up (4–16 weeks after treatment completion). A total of six groups were conducted. Two groups met once per week with follow-up at 16-weeks, and four groups met twice per week with follow-up between four-to-six weeks. Although group frequency varied, the number of sessions and hours engaged in intervention remained the same. Consistent caregiver attendance was encouraged and some families had two caregivers attend some sessions. However, the same caregiver filled out data at each timepoint. Data were analyzed and collapsed across groups as outcomes did not differ between group variations. Approval for this study was granted by the Institutional Review Boards of [Virginia Tech, Emory University, and Children’s Healthcare of Atlanta].

**P4P Treatment.** The format for groups followed the unpublished P4P manual, made available by the UCLA PEERS® Clinic. P4P integrates elements from empirically supported social skills intervention established by the UCLA PEERS® program (Laugeson et al., 2009; Laugeson & Park, 2014). Groups consisted of 16 one hour and 30min sessions that met either once or twice per week. Each P4P group consisted of two-to-five children with four-to-seven student clinicians. All clinicians were trained on P4P through a one-day intensive training, receipt of materials, and case conference meetings before each session. Group leaders included psychology doctoral students, psychology master’s students, and undergraduate students pursuing their bachelor’s degrees. Groups were supervised by an advanced graduate student clinician and licensed clinical psychologist.

P4P was adapted from the adolescent and young adult versions of the PEERS® to target developmentally appropriate social skills for young autistic children (e.g., listening to and following directions, greeting friends, sharing and giving turns, keeping cool, being flexible, asking friends to play, transitioning activities, maintaining appropriate body boundaries). Skills were taught through play activities including a live puppet show and games for rehearsing and reinforcing newly learned skills. While children participated in group instruction, caregivers engaged in a parallel group where they learned social coaching skills and reviewed homework assignments to individualize the successful utilization of skills. As part of the developmental adaptation, the

last 30minutes were devoted to caregiver-coached play, in which caregivers provided social coaching to their children during in-group dyadic playdates. Simultaneously, caregivers received in-vivo performance feedback on their social coaching from a clinician seated next to them.

**Community Involvement.** The autistic community and autism allies (i.e., parents and caregivers) were involved in the development of the intervention during stakeholder focus groups with program developers and the implementation of the current study through ongoing feedback regarding feasibility of group meetings (e.g., consistency and timing of meetings, locations). Further, the PEERS® developers have a history of involving autistic self-advocates and stakeholders in the development and testing of all PEERS® programs.

## Measures

**Social Responsiveness Scale, 2nd Edition (SRS-2; Constantino & Gruber, 2012).** The SRS-2 is a 65-item questionnaire used to measure the level of autistic traits. This questionnaire was used to measure social communication difficulties and RRB. Caregivers were asked to rate each item on a four-point scale from “1” (Not True) to “4” (Almost Always True). Higher T-scores indicate greater autistic traits. Social Communication Impairment (SCI) Index and RRB Index T-scores were used in the analyses. Cronbach’s alphas for total SCI and RRB T-scores at pre-treatment ( $\alpha=0.96/0.88$ ), post-treatment ( $\alpha=0.97/0.91$ ), and follow-up ( $\alpha=0.96/0.86$ ) were in the good-to-excellent range.

**Social Skills Improvement System (SSiS; Gresham & Elliot, 2008).** The parent version of the SSiS is a 79-item measure used to assess social skills and behavioral difficulties. The SSiS Social Skills Scale is composed of seven subscales: Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-Control. The SSiS Problem Behaviors Scale is composed of five subscales: Externalizing, Bullying, Hyperactivity/Inattention, Internalizing, and Autism Spectrum. Caregivers were asked to rate each item on a four-point scale ranging from “0” (Never) to “3” (Almost Always). Higher scale scores indicate better social skills or more severe behavioral difficulties. For the single subject analysis we used T-scores, as reliability measures from literature are required for calculations. For regression analyses, total raw scores were used as we did not want to include covariance related to autistic traits in the Problem Behaviors scale. Thus, to ensure our results were capturing problem behaviors, we modified scores for the Problem Behavior scale to exclude items from the Autism Spectrum subscale. Cronbach’s alphas for this sample were in the acceptable-to-good range for the

Social Skills and Problem Behaviors scales at pre-treatment ( $\alpha=0.81/\alpha=0.90$ ), post-treatment ( $\alpha=0.82/\alpha=0.87$ ), and follow-up ( $\alpha=0.76/\alpha=0.84$ ).

### Statistical Analysis Plan

**Single-Subject Analysis (Aim 1).** A reliable change index (RCI) was calculated for each subject to determine within-subject change relative to within-person measurement error for social skills, behavioral difficulties, SCI, and RRB. RCIs reflect the magnitude of change above and beyond standard error. RCI calculations were completed by dividing the difference of scores between two timepoints by the standard difference, which includes test-retest reliability and standard deviation of the original measure (Jacobson & Truax, 1991). The test-retest reliabilities and standard deviations used to compute the standard difference score were obtained from the literature. If test-retest reliability was not previously reported, then Cronbach's alpha from the literature was used in place. RCI values above/below 1.96 are suggested to infer statistically significant and meaningful change within participants. For social skills: positive RCI scores indicated improvement and negative RCI scores indicated deterioration. For behavioral difficulties, RRB, and social communication difficulties: negative RCI scores indicated that scores decreased, suggesting improvement, while positive RCI scores indicated an increase, suggesting deterioration.

**Regression Analyses, including Missing Data, and Imputation (Aim 2).** As the sample size of participants that completed the treatment is small ( $n=22$ ), analyses were completed to examine missing data and determine whether imputation methods were appropriate to use on the participants who had missing data at post-treatment ( $n=7$ ; 31.82% missing) and follow-up ( $n=9$ ; 40.91% missing). A Little's Missing at Completely Random (MCAR) Test was completed to determine whether data were missing at random, such that a significant  $p$ -value indicates that data is not missing at random. An insignificant result suggests that mean and variance of the overall sample from the complete cases can be used to estimate missing cases. This method has been used for treatment studies with small sample sizes (i.e., Chenausky et al., 2018; Rose et al., 2020). Linear regressions were conducted to examine whether core autistic traits at pre-treatment predicted post-treatment and follow-up social skills and behavioral difficulties. Standardized  $\beta$  coefficients are noted in the results section, while unstandardized  $b$  coefficients are reported in the tables. Additionally, we used a Bonferroni correction of  $p<.025$  to account for multiple comparisons of each SRS-2 scale on each outcome of interest for each time point.

## Results

### Individual Outcomes

RCI results are presented in Table 3. Regarding the primary outcome of the intervention, social skills, we found that 60% (9/15) of children demonstrated improvement at post-treatment, and 53.85% (7/13) of children demonstrated improvement at follow-up. Regarding secondary outcomes of the intervention (i.e., behavioral difficulties, social communication difficulties, and RRB), we found that 33.33% (5/15) of children demonstrated reduction in behavioral difficulties at post-treatment, and 7.69% (1/13) of children demonstrated reduction at follow-up. Regarding social communication difficulties, 2.25% (1/16) of children demonstrated reduction at post-treatment, and 18.75% (3/16) of children demonstrated reduction at follow-up. Regarding RRB, 25% (4/16) of children demonstrated reduction at post-treatment, and 31.25% (5/16) of children demonstrated reduction at follow-up.

### Predictors of Post-Treatment Outcomes

Results from the Little's MCAR test revealed that data were missing at random,  $\chi^2(42)=40.53$ ,  $p=.54$ , thus, imputations were appropriate for analyses (Table 4). Pre-treatment social communication difficulties and RRB were separately used to predict post-treatment social skills and behavioral difficulties. Lower pre-treatment social communication difficulties significantly predicted greater social skills at post-treatment,  $\beta = -0.73$ ,  $t = -4.81$ ,  $p < .001$ , and accounted for 54% of the variance in post-treatment social skills,  $R^2 = 0.54$ ,  $F(1, 20) = 23.13$ ,  $p < .001$ . Lower pre-treatment social communication difficulties significantly predicted lower behavioral difficulties at post-treatment,  $\beta = 0.49$ ,  $t = 2.48$ ,  $p = .02$ , and accounted for 24% of the variance in post-treatment behavioral difficulties,  $R^2 = 0.24$ ,  $F(1, 20) = 6.16$ ,  $p = .02$ . Pre-treatment RRB did not predict social skills at post-treatment ( $p > .13$ ). Lower pre-treatment RRB significantly predicted lower behavioral difficulties at post-treatment,  $\beta = 0.45$ ,  $t = 2.25$ ,  $p = .04$ , and accounted for 20% of the variance in post-treatment behavioral difficulties,  $R^2 = 0.20$ ,  $F(1, 20) = 5.06$ ,  $p = .04$ .

### Predictors of Follow-Up Outcomes

Pre-treatment social communication difficulties and RRB were separately used to predict follow-up social skills and behavioral difficulties. No significant effects were found for pre-treatment social communication difficulties on follow-up social skills or on behavioral difficulties ( $ps > 0.10$ ). No significant effects were found for pre-treatment RRB

**Table 3** Single-subject analysis for Pre/Post and Pre/Follow-up

Participant	SRS-2				SSiS			
	SCI Index		RRB Index		Social Skills		Behavioral Difficulties	
	Pre/Post n = 16	Pre/Follow-up n = 16	Pre/Post n = 16	Pre/ Follow-up n = 16	Pre/Post n = 15	Pre/Follow-up n = 13	Pre/Post n = 15	Pre/Follow-up n = 13
1	0.63	-1.10	-2.83*	-4.48*	2.44*	4.69*	-1.07	0.46
2		-1.72		-3.00*				
3	-0.16	-0.63	-1.073	-1.88	2.10*	3.46*	0.91	0.75
4	-0.65	-1.47	-0.68	-0.68	-1.75	-0.99	1.61	1.77
5	-0.15	-0.29	2.95	1.34	3.14*	4.19*	4.37	3.02
6		-1.17		-3.76*		4.20*		-1.41
7		-4.54*		-5.89*		3.46*		-2.30*
8		0.58		0.00		0.49		1.41
9	-3.60*	-2.50*	-2.68*	0.00	3.49*	7.66*	0.00	0.00
10		-0.78		-1.18		0.74		-0.31
11	0.16		0.00		0.35		-3.21*	
12	-1.56	-2.19*	-0.24	1.18	4.71*	6.42*	-1.96*	-0.75
13	1.14	0.00	4.09	0.68	0.87	1.73	-0.71	0.18
14	-0.44	0.00	-1.07	1.07	-1.05	0.49	0.00	-0.30
15	0.78	0.63	3.76	3.76	-0.35	0.00	2.72	1.35
16	0.16		0.00		-1.46		0.00	
17	0.98		-0.34		6.49*		2.47	
18	-0.31		-2.36*		8.11*		-1.96*	
19	0.33		0.00					
20	-0.16	-0.63	-1.65	-0.47	8.59*		-2.72*	
21	1.47	-0.49	-4.77*	-2.05*	10.54*		-5.48*	
22								

Note: Reliable change indices were calculated for Pre/Post and Pre/Follow-up. Significant values (\*) are +/- 1.96

**Table 4** Regression coefficients for core autistic traits predicting post-treatment and follow-up outcomes

Effect	<i>b</i>	<i>b SE</i>	95% Confidence Interval		<i>t</i>	<i>p</i>
			<i>Lower Limit</i>	<i>Upper Limit</i>		
Post-Treatment Outcomes						
Social Skills						
Intercept	130.05	12.39			10.50	<0.001***
<b>SCI</b>	<b>-0.83</b>	<b>0.17</b>	<b>-1.16</b>	<b>-0.50</b>	<b>-4.81</b>	<b>&lt;0.001***</b>
Intercept	100.73	19.33			5.21	<0.001***
RRB	-0.38	0.25	-0.87	0.11	-1.55	0.14
Behavioral Difficulties						
Intercept	-2.39	16.20			-0.15	0.88
<b>SCI</b>	<b>0.56</b>	<b>0.22</b>	<b>0.13</b>	<b>0.99</b>	<b>2.48</b>	<b>0.02*</b>
Intercept	-4.11	18.60			-0.22	0.83
<b>RRB</b>	<b>0.53</b>	<b>0.24</b>	<b>0.06</b>	<b>1.00</b>	<b>2.25</b>	<b>0.04*</b>
Follow-up Outcomes						
Social Skills						
Intercept	96.29	14.92			6.45	<0.001***
SCI	-0.35	0.21	-0.76	0.06	-1.67	0.11
Intercept	72.30	17.90			4.04	<0.001***
RRB	-0.008	0.23	-0.46	0.44	-0.04	0.97
Behavioral Difficulties						
Intercept	17.40	15.02			1.16	0.26
SCI	0.29	0.21	-0.12	0.70	1.41	0.18
Intercept	0.38	15.50			0.03	0.98
<b>RRB</b>	<b>0.49</b>	<b>0.20</b>	<b>0.10</b>	<b>0.88</b>	<b>2.47</b>	<b>0.02*</b>

Note. Total N=22. Imputation used for 7 participants at post-treatment, and 9 participants at follow-up

on follow-up social skills ( $p > .96$ ). Lower pre-treatment RRB significantly predicted lower behavioral difficulties at follow-up,  $\beta = 0.48$ ,  $t = 2.47$ ,  $p = .02$ , which accounted for 23% of the variance in follow-up behavioral difficulties,  $R^2 = 0.23$ ,  $F(1, 20) = 6.08$ ,  $p = .02$ .

## Discussion

This study aimed to examine the preliminary child outcomes of P4P on social skills, behavioral difficulties, social communication difficulties, and RRB, and further examine whether core autistic features predicted treatment outcomes. Results indicated social skills improvement as measured by the *SSiS* for the majority of participants at post-treatment, which were sustained for about half at follow-up. Regarding behavioral difficulties as measured by the *SSiS*, one-third of participants had a reduction at post-treatment, though these gains were generally not sustained at follow-up. Although P4P does not specifically target autistic traits, a small subset of participants showed reductions as measured by the *SRS-2*. Together, these findings generally support positive P4P effects on child outcomes. Regarding the role of core autistic features on social skills and behavioral outcomes, less social communication difficulties predicted both greater social skills and less behavioral difficulties at post-treatment but not follow-up, while less RRB predicted less behavioral difficulties at both post-treatment and follow-up. Thus, core autistic traits may differentially impact P4P post-treatment and follow-up outcomes.

Within the broader literature of group-based social skills interventions for autistic people (ages 6–25 years) using the *SSiS*, moderate effects have been found for social skills improvement, though reductions in behavioral difficulties following treatment have not been consistently reported (Wolstencroft et al., 2018). Although we found that young autistic children generally demonstrated social skills improvement following P4P and maintained social skills, only a subset of participants demonstrated reductions in behavioral difficulties and these changes were generally not sustained. These findings are generally consistent with previous studies on P4P (Factor et al., 2022b, c; Park et al., 2022; Tripathi et al., 2021). It is important for future work to examine both child and parent factors that impact sustenance of treatment gains. For example, recent work has demonstrated that parental broader autism phenotype characteristics (i.e., parental pragmatic language, rigidity) are linked to poorer child emotion regulation and inhibitory control, and thus, these factors may impact sustenance or generalizability of skills (DeLucia et al., 2021). More work is needed in uncovering predictors, mediators, and moderators of P4P outcomes.

Although the *SRS-2* measures autistic traits, this measure has historically been used as an outcome measure of social skills interventions as it captures social communication difficulties that are common in autistic people and relevant in this context. Importantly, although we use the *SRS-2*, the aim of P4P is not to diminish autistic traits, but rather to teach a set of ecologically valid skills related to social responsiveness that can be used if desired. Our results indicated that only a small subset of participants improved on the *SRS-2*, which is inconsistent with previous P4P papers that found significant reductions at post-treatment (Park et al., 2022; Tripathi et al., 2021), and reports of large effects in reductions of autistic traits following group social skills interventions more broadly (Wolstencroft et al., 2018). Our conflicting results may be explained by work suggesting that the *SRS-2* is a screening measure, which may not be sensitive to change or appropriate to use as a treatment endpoint measure (Anagnostou et al., 2014). Finally, although previous literature has found large effects for the *SRS-2*, recent intervention work has illustrated that large group-level effects do not always translate to most people getting better, further emphasizing the need for individual outcomes (Jensen & Corrales, 2017).

In considering processes of effect in P4P, it is perhaps the unique focus on teaching social rules and concrete steps of social behavior that may have contributed to the observed benefits. Increased social competence coupled with social engagement may result in a positive feedback loop, such that there are increasingly successful social interactions, which may reduce future social apprehension. Consistent with studies highlighting the positive impact of including caregivers in interventions (McConachie & Diggle, 2007), caregiver involvement may have bolstered positive outcomes. Caregivers, who served as active social coaches, practiced skills in socially safe settings, potentially mitigating difficulties through repeated practice. These repeated opportunities might have enhanced generalization of skills, while also increasing social competency in children.

The behavioral principles used to teach social skills in P4P are similar to positive approaches of parent-child interaction training (Eyberg & Matarazzo, 1980; Michelson et al., 2013), such that there is a dual reinforcement schedule, which allows for positive reinforcement of child social skills from caregivers, and of caregiver facilitation from clinicians. This reinforced interaction may generalize to other behaviors. Thus, although P4P targets social skills, the caregiver-child interaction may generalize to behavioral difficulties. For example, self-regulation and emotion regulation may be particularly relevant to some P4P modules (e.g., body boundaries, giving and taking turns, keeping cool) which are associated with behavioral difficulties. Future work should focus on how child emotion- and

self-regulation impacts outcomes, especially considering work demonstrating that co-occurring ADHD may negatively impact social skills intervention outcomes (Antshel et al., 2011) and that self-regulation impacts friendship quality and loneliness in autistic children (Nuske et al., 2021).

Understanding how core autistic traits impact treatment results allows for researchers and clinicians to better emphasize certain components of treatments for different people in order to maximize treatment gains. This approach is particularly important considering the heterogeneity of autistic people. Our findings revealed that core autistic traits may differentially impact outcomes. Interestingly, greater RRB predicted both greater post-treatment and follow-up behavioral difficulties. These initial findings elucidate that young autistic children who present with high RRB may also have more long-lasting behavioral difficulties, which is consistent with longitudinal work in autistic children (Greenlee et al., 2021). Based on these preliminary findings, it may be helpful to emphasize specific P4P modules that target behavioral difficulties for children who present with high RRB.

It is still unclear what mechanisms underlie the links between RRB and behavioral difficulties following P4P. The RRB measure used in this study did not allow for assessment of RRB subtypes and future work would benefit from using more detailed measures. For example, insistence on sameness and self-injurious behavior have specifically been linked to certain behavioral (i.e., internalizing) difficulties and developmentally these difficulties may externalize (i.e., outbursts/tantrums) in young children (Fraire & Ollendick, 2013). Cognitive flexibility may be one underlying mechanism that may aid in our understanding of this translation (Hollocks et al., 2021). Although P4P targets social skills explicitly, it may also inadvertently impact cognitive flexibility, such that these tools allow for children to regulate their behaviors more flexibly and readily, and these preliminary findings may begin to shed light on this connection (Mazefsky et al., 2012). More work is needed in understanding how changes in RRB impact changes in behavioral difficulties, and vice versa, and whether these changes rely on similar physiological or neural mechanisms (Condy et al., 2017; Nuske et al., 2019; Yerys et al., 2015).

## Limitations

Although this preliminary intervention study presents a number of critical results, there are important limitations. While small sample sizes are common in intervention studies for autistic people (Slaughter et al., 2020), it may have restricted our detection of medium/small effects. Relatedly, we had missing data, though we statistically accounted for this limitation. Although statistical analyses did not indicate differences in outcomes related to different

treatment timelines it is imperative for future research to employ an RCT with greater standardization of treatment across cohorts. Additionally, as there was not a waitlist-control group, it is difficult to disentangle whether results demonstrating improvement and sustainability of gains at follow-up (i.e., social skills) are related to the intervention or developmental maturation. We were additionally limited by the reliance on caregiver-report measures (Whittingham et al., 2009), as caregiver involvement may bias outcomes (White et al., 2007). Future work should include observational and objective (i.e., task) measures of social skills (Gates et al., 2017) in a larger and more ethnically diverse sample. Regarding diversity and generalizability of this sample, our sample was primarily White, with a large range in socioeconomic status and educational attainment. Interestingly, we had a high percentage of young autistic girls (40.9%) participate, as compared to previous P4P studies reporting about 20–25% girls. Previous work has demonstrated that gender does not impact PEERS® outcomes (McVey et al., 2017), though autistic females may have more insistence on sameness and self-injurious behavior (Antezana et al., 2019), and these links to behavioral difficulties may have partly impacted our findings.

## Future Directions

P4P child outcomes are only one sliver of the larger biosocial systems that contribute to social functioning and well-being in autism (Scarpa et al., 2021). Future work should not only investigate intra-individual factors (i.e., child emotion regulation, self-regulation, cognitive flexibility) related to P4P, but also inter-individual factors (i.e., parent-child interactions, family/caregiver outcomes). Detailed measurement over the course of treatment and longitudinal follow-up may aid in examination of caregiver-child dyadic interactions that allow for P4P success (Factor et al., 2019; Karst & Van Hecke, 2012). Moreover, there is a need for broader social systems at large to uplift autistic voices, promote awareness and acceptance of autistic differences, and foster inclusive and safe environments (Jones et al., 2021). Finally, although social skills interventions have been tied to numerous well-being outcomes, emerging work has indicated that some social skills interventions may contribute to masking/camouflaging behaviors for autistic people, which can lead to negative mental health outcomes in adulthood (Bottema-Beutel et al., 2020). Taking this work into serious consideration, it is important to clarify that the goal of P4P is not to decrease autistic traits, but to teach a set of ecologically valid skills that may aid in navigating the social world for anyone who struggles to make and keep friends. P4P emphasizes volition in using these skills, and the importance of finding accepting friends with common

interests. It is also important for future work to examine the acceptability of P4P in autistic youth and further examine the ecological validity of P4P in this younger population, paralleling work in PEERS® for adolescents and adults. Although more research is needed to examine the impact of social skills interventions for young autistic children, emerging P4P results indicate generally positive outcomes (Factor et al., 2022b, c; Park et al., 2022; Tripathi et al., 2021).

## Conclusion

Caregiver-mediated social skills group interventions may be particularly helpful for young autistic children. Our results generally demonstrate positive outcomes following P4P, though more work is needed in understanding factors that influence longitudinal treatment gains and maintenance. Finally, core autistic traits may predict outcomes following P4P, and may reveal mechanistic changes (i.e., cognitive flexibility) for future work.

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