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Improving Social Anxiety and Social Responsiveness in Autism Spectrum Disorder through PEERS®

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ABSTRACT

Autistic individuals often experience anxiety at higher rates than typically developing individuals, which could worsen social impairment. While anxiety is highly linked to social skills, social anxiety symptoms have not often been investigated within the context of social skills interventions. The present study compared changes in social anxiety and social responsiveness in 154 adolescents and young adults on the autism spectrum participating in the Program for the Education and Enrichment of Relational Skills (PEERS®) social skills intervention. Results indicate that social anxiety symptoms significantly improved following treatment for both adolescents and young adults. Although young adults reported higher levels of anxiety overall, age group did not moderate social anxiety outcome, with both groups demonstrating comparable social anxiety improvements following treatment. Further, greater improvements in social responsiveness following PEERS® were associated with greater reductions in social anxiety symptoms. We also examined reporter agreement (e.g., self- and caregiver-reports), which indicated these reports were largely consistent, though correlations between adolescent and caregiver-report increased from pre- to post-treatment. Findings suggest that social skills interventions may play a critical role in the reduction of mental health symptoms, such as anxiety symptoms, for autistic adolescents and young adults.

Individuals on the autism spectrum are at significantly higher risk for comorbid mental health problems than the general population across the lifespan (Buck et al., 2014; Simonoff et al., 2008). Among autistic children and adolescents,[1] approximately 70% have at least one comorbid diagnosis, and at least 40% have two co-occurring mental health conditions (Simonoff et al., 2008); further, autistic adults also demonstrate increased rates of all major psychiatric disorders (Croen et al., 2015). Anxiety disorders are one common comorbidity in autistic youth and adults, with estimates that between 30% and 84% of individuals on the autism spectrum present with clinically significant anxiety symptoms (Smith et al., 2019; Van Steensel et al., 2011; White et al., 2009). Prior research has demonstrated that co-occurring anxiety symptoms can exacerbate negative outcomes observed in autistic populations, such as depressive symptoms, poor quality of life, behavioral dysregulation (e.g., self-injury, aggression), and elevated parental stress

(Kerns & Kendall, 2012; Kerns et al., 2015; Smith et al., 2019). Further, high anxiety levels have been posited as both a moderator of autistic symptom severity and a byproduct of autism-related symptoms (Wood & Gadow, 2010).

Social communication differences are one of the core features of autism spectrum disorder (ASD; Association, 2013). The presence of co-occurring anxiety, which is independently associated with social difficulties (Kerns et al., 2015; Rao & Landa, 2014), can further exacerbate the negative impact on social functioning and relationships in people on the spectrum. The overlap between ASD and anxiety has been widely studied, with a nearly 30-fold increase in publications on this topic in recent years (Vasa et al., 2018). Given the prevalence, functional impairments, and distress associated with co-occurring anxiety symptoms for autistic individuals, it is essential to determine the symptom impact and methods to mitigate anxiety symptoms in this vulnerable population.

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[1]Many self-advocates from the autism community (Bury et al., 2020) prefer identity first language (e.g., autistic children) or language describing the individual (e.g., on the spectrum). Therefore, this language will be utilized throughout the present manuscript.

Current evidence suggests adapted Cognitive-Behavioral Therapy (CBT) approaches are effective in reducing anxiety symptoms in autistic populations, with other approaches such as mindfulness-based interventions and psychopharmacology also being employed successfully (White et al., 2018). Despite this growing intervention focus, the majority of research has examined program outcomes in children and adolescents, while minimal treatment studies for anxiety in autistic adolescents and adults exist (White et al., 2018). Work by White et al. (2013)is one of the few that addresses adults with comorbid ASD and anxiety (e.g., MASSI, STEPS program). Given the heightened prevalence of co-occurring mental health conditions and high service needs among autistic adolescents and adults (Croen et al., 2006; Weiss et al., 2018), interventions that simultaneously address multiple-treatment targets would be time- and cost-effective, reducing burden on the autism community. Given the intersection of social anxiety and social communication, one such potential alternative treatment approach becoming more prevalent is applying CBT tenets in the context of a social skills training program (Moody & Laugeson, 2020). The Program for the Education and Enrichment of Relational Skills (PEERS®) has been established as one of the only evidence-based social skills treatments for autistic adolescents and young adults with ASD and other social impairments (see Laugeson et al., 2012). The current study sought to expand upon the burgeoning literature on co-occurring anxiety and ASD (Vasa et al., 2018) through the examination of social anxiety in the context of an evidence-based social skills intervention, PEERS®.

Social impairments in ASD and anxiety

While distinct clinical phenomena, ASD and anxiety can both result in clinically significant social impairments, whether through social communication challenges, differences in social cognition, anxious avoidance, or physiological and cognitive distress in social situations (Association, 2013). Diagnostic characteristics of autistic individuals include challenges and differences in understanding nonverbal communication, social-emotional reciprocity, perspective-taking, and developing meaningful relationships across the lifespan (Association, 2013).

Signs of social reciprocity differences (e.g., reduced frequency of social smiling, eye contact) are often present pre-verbally in individuals later diagnosed with ASD (Neimy et al., 2017; Mundy, 2016) and can worsen (Rao et al., 2008). The second core domain of ASD, engagement in restricted and repetitive behaviors (RRBs; APA, 2013), has also been linked to social communication differences (Factor et al., 2016; Ray-Subramanian & Weismer, 2012), such as perseverating on topics of interest, as well as increased anxiety related to more RRB expression (Factor et al., 2016).

Though all forms of anxiety can interfere with social functioning, social anxiety often results in the most significant impairments (Association, 2013). With onset typically in adolescence, social anxiety encompasses fear of negative evaluation, adverse physiological responses to and avoidance of social situations (Stein & Stein, 2008). Social anxiety is associated with greater social difficulties in autistic children (Joosten et al., 2009) and lower social motivation in adults (Swain et al., 2015). Symptoms of social anxiety have been linked with deficits in perspective taking, communication, social skills, and peer acceptance (Halls et al., 2015; Hezel & McNally, 2014; Pickard et al., 2017). Thus, symptom commonality suggests possible treatment overlap.

Intersection of ASD and social anxiety

Given social impairments present in both diagnoses, estimates suggest nearly 50% of autistic individuals also exhibit elevated social anxiety symptoms (Spain et al., 2018). This notable diagnostic comorbidity can be theoretically explained by bidirectional relationships between autism-related social difficulties and social anxiety (Bellini, 2006; White et al., 2014). For example, autistic individuals may be more likely to experience social challenges (e.g., teasing, exclusion) and heightened physiological arousal, which may increase social anxiety through fear of negative evaluation and subsequent avoidance. While anxiety may be a negative sequela of autism-related social impairments, it is also possible that the presence of anxiety symptoms may exacerbate ASD symptom severity (Kerns et al., 2015; Wood & Gadow, 2010).

Previous research has confirmed linkages between ASD-related social challenges and anxiety symptoms. Maddox and White (2015)posited that increased desire for social interaction could account for heightened social anxiety in autistic individuals. Furthermore, autistic youth reported to have more severe ASD symptomatology tend to present with heightened anxiety (Factor et al., 2017; Spain et al., 2018). One study found autistic youth with social anxiety had greater deficits in assertiveness (i.e., initiating social interactions) and social responsivity (i.e., awareness of social rules) than those without social anxiety (Chang et al., 2012).

Co-occurring anxiety symptoms appear to remain relatively stable or worsen throughout development for autistic individuals (Baribeau et al., 2021; Davis III et al., 2011; Gotham et al., 2015). Beyond the distress associated with these symptoms, mental health problems and social impairments predict significant negative outcomes for autistic individuals across the lifespan (e.g., poorer quality of life; Mason et al., 2019). As an individual matures, social differences may impact peer relationships, through less time spent interacting with peers and poorer-quality social exchanges (Sigman et al., 1999). Although autistic children often endorse a desire for more peer interactions, they also report having fewer friends, diminished friendship reciprocity, and more loneliness than their typically developing peers (Bauminger & Kasari, 2000; Kasari et al., 2011). This lack of close reciprocal friendships deprives autistic youth of protective effects of friendship against depression and anxiety later in life (Wright & Wachs, 2019). Social impairments can result in more rejection and victimization, which show robust relations with adverse health, psychological, vocational, and relational outcomes through adulthood (Moore et al., 2017; Wolke & Lereya, 2015). These findings further highlight the need to examine the intersection of anxiety and social functioning in those on the spectrum to inform appropriate treatment targets.

Measurement of anxiety in ASD

Measurement is another important consideration in evaluating social anxiety symptoms in autistic individuals. Even within a neurotypical population, discrepancies in reports of mental health symptoms vary by informant (e.g., self, caregiver). Increased agreement is frequently observed with respect to externalizing symptoms and more observable behaviors (e.g., aggression, rule-breaking). In contrast, internalizing symptoms, such as anxiety and depression, are characterized most strongly by the internal experiences of an individual (e.g., emotions, cognitions, sensations), and thus, are not as readily apparent or easily agreed upon (Grills & Ollendick, 2002). These patterns are observed in anxiety-specific symptoms, with greater accordance across reporters for observed behaviors (Comer & Kendall, 2004), though findings suggest reports of social anxiety differ more across autistic youth and their caregivers than in neurotypical populations (Schiltz et al., 2021). Previous researchers have documented concerns regarding the use of self-report in autistic individuals (Mazefsky et al., 2011), while others have advocated for the utility of self-report measures (Keith et al., 2019). Studies examining predictors of social anxiety have found discrepant results based on reporter (Swain et al., 2015). Thus, identifying patterns across reporters in the detection of and processes involved in anxiety in autistic individuals is essential to proper assessment and treatment.

Evidence-Based interventions

The frequent overlap of ASD and social anxiety suggests that an intervention that targets social skills specifically for those with autistic and social anxiety symptoms is not only warranted, but necessary. A survey of the literature reveals CBT, an evidence-based intervention employing exposure, modeling, and cognitive restructuring, is the most utilized intervention to treat anxiety, and is appropriate for all ages (Higa-mcmillan et al., 2016). Adapted CBT has been deemed effective to target anxiety in autistic individuals, while still championing the same tenets of classic CBT with slight adjustments in treatment structure. Modifications include using more concrete tools/supports, incorporation of ASD-related symptoms (e.g., restricted interests), psychoeducation, and caregiver involvement (Moree & Davis III, 2010).

The Behavioral Interventions for Anxiety in Children with Autism (BIACA; Storch et al., 2013; Wood et al., 2009) is an adapted CBT intervention that has successfully reduced anxiety and ASD

symptoms in autistic school-aged children. This program includes parent-coaching to assist with generalization and integrates modular interventions beyond standard CBT (e.g., cognitive restructuring, exposures, relaxation) that promote effective social skills and communication. Despite this potential, results from a randomized control trial (RCT) of BIACA in adolescents showed improvements on only one of four measures of anxiety (Wood et al., 2015). Given the interwoven nature of ASD and social anxiety symptoms, interventions that target social skills and functioning may produce benefits through reductions in both symptoms.

Another CBT program, the Multimodal Anxiety and Social Skills Intervention (MASSI), for adolescents on the spectrum similarly resulted in improvements in ASD symptom severity, but no significant effects on anxiety measures (White et al., 2013). An increased emphasis on friendship formation and engagement in conversations in the broader social context of adolescence through adulthood may provide support for the need for socially oriented treatments for autistic adolescents and young adults. More investigation into age and developmental stage in interventions for autistic individuals is also needed.

Moreover, only a few studies have examined how social anxiety may moderate treatment response in ASD samples, with mixed findings. One study showed that in a treatment targeting both anxiety and social skills, youth with more pronounced social anxiety showed greater improvements in social functioning and reductions in social impairments (Maddox et al., 2017). More research is needed to understand the intersection of social anxiety and autism-related social impairments, especially in intervention contexts at adolescence and adulthood.

If social anxiety is a sequela of autism-related social differences, a more effective route to produce benefits across both constructs may be to primarily target social skills. Indeed, limited research has suggested evidence-based social skills treatments are effective in reducing anxiety symptoms in autistic individuals (Hillier et al., 2011; Schohl et al., 2014; Spain et al., 2017), yet prior studies have not directly tested whether changes in social skills following such treatments are associated with changes in social anxiety. Therefore, it remains unclear whether benefits from social skills intervention may be related to improved social competence, or to any number of other treatment processes (e.g., participating in a group therapy modality, which might be a type of exposure). Additionally, many autistic individuals experience sub-clinical levels of anxiety (Adams et al., 2019), often unrecognized, misdiagnosed, or overshadowed by the broader ASD diagnosis (MacNeil et al., 2009). Thus, social skills interventions may be particularly helpful for individuals for whom anxiety-focused treatment may not be indicated.

PEERS® has been established as one of the few evidence-based social skills treatments for autistic adolescents and adults, employing empirically supported CBT methods of social skills instruction (e.g., concrete didactic instruction, role-play modeling, behavioral rehearsal, generalization assignments outside of session). In addition to a structured adolescent/young adult group component, PEERS® also includes a simultaneous caregiver/social coach group that includes psychoeducation, review of skills, and social coaching strategies. This method of intervention delivery has been established as efficacious in improving social skills across multiple RCTs with autistic adolescents (Garbarino et al., 2020; Laugeson et al., 2009; Laugeson et al., 2012; Van Hecke et al., 2015) and young adults (Gantman et al., 2012; Laugeson et al., 2015; McVey et al., 2016), with maintained improvements (e.g., post-intervention and 1-to-5-year follow-ups; Mandelberg et al., 2014). PEERS® has been adapted to be administered in school-settings (Mandelberg et al., 2014), into over a dozen languages, and employed in over 125 countries.

Beyond social skills, reductions in depression, suicidality, and anxiety in adults following PEERS® have been observed (Laugeson et al., 2012; Schiltz et al., 2018). Other results suggest that adolescents participating in PEERS® groups reported increased social engagement, knowledge of friendship skills, and decreases in problem behavior, and social anxiety (Schohl et al., 2014). Results suggest PEERS® is effective regardless of gender, across different developmental stages, and has also been shown to decrease family stress (Karst et al., 2015; McVey et al., 2017). Methods employed by PEERS® may

be especially beneficial to those experiencing clinically elevated anxiety symptoms as the treatment itself may be a series of exposures (e.g., assignments to socialize with peers, join social groups). Applying social skills interventions to improve social functioning may prevent future mental health difficulties, specifically social anxiety, in those on the autism spectrum. Research suggests that having one or two close friends can buffer the impact of stressful events and positively correlates with self-esteem and independence (Buhrmester, 1990; Matson et al., 1998). Therefore, improving social skills through targeting friendships may have additional value for those with ASD and anxiety.

Aims and hypotheses

Taken together, the present study aimed to extend the current literature focusing on ASD and social anxiety symptoms to explore how changes in social impairments following the PEERS® social skills intervention may moderate outcomes related to social anxiety. This was accomplished through investigating three aims: 1) the role of social anxiety in moderating treatment response to a social skills intervention, 2) the response of social anxiety to social skills intervention, and 3) the relation between changes in social impairments and changes in social anxiety following a social skills intervention. Throughout all three aims, the moderating role of age group (adolescents or young adults), was tested to examine treatment processes across developmental periods as well as concordance of reporter outcomes. We hypothesized that 1) social anxiety would moderate social skill interventions, 2) higher levels of anxiety would lead to decreased social skill gains, and 3) more changes in social impairments (e.g., less impairment) would be seen in individuals with greater decreases in social anxiety following PEERS®.

Method

Participants

Participants were drawn from a clinical database of individuals who were referred to and participated in the UCLAPEERS® programs through an outpatient clinical setting following a history of

social difficulties. As part of the screening process, all participants were assessed for motivation to participate in and appropriateness for a group-based social skills therapy setting, through a phone screen and then an intake appointment with a postdoctoral psychology fellow or licensed clinical psychologist. Intake assessors also utilized clinical judgment to determine whether participants would be able to comprehend session content in a group-based treatment, though cognitive assessments were not completed. Depending on age, participants enrolled in the evidence-based PEERS® for Adolescents or PEERS® for Young Adults caregiver-assisted social skills intervention (Laugeson, 2017; Moree & Davis III, 2010).

From the larger clinical outcome database, participants with a previous diagnosis of ASD confirmed by a baseline elevated caregiver-report (e.g., parent, life coach, therapist, family member) of current ASD symptomatology on the Social Responsiveness Scale, Second Edition (SRS-2; Total Score ≥ 60; Constantino & Gruber, 2012) were selected for the current study (n = 154). Adolescent participants (n = 68) ranged from 11 to 17 years (M = 13.94, SD = 1.89), while young adults (n = 86) ranged from 18 to 35 years (M = 22.22, SD = 3.70). Of the 154 participants, 121 identified as male (78.6%), 95 (61.7%) identified as Caucasian, 18 (11.7%) as Latino/Hispanic, 18 (11.7%) as Asian, 12 (7.8%) as Multiracial, five (3.2%) as African American, and six (3.9%) as other (see Table 1). Of the 154 participants, 57 (37%) reported one or more comorbid mental health diagnoses. The most common comorbid diagnosis was Attention Deficit/Hyperactivity Disorder (ADHD; n = 28), followed by internalizing disorders, such as anxiety (n = 8) and depression (n = 5). Though there is a low incidence of formal social anxiety diagnoses reported in this sample, many participants reported elevated social anxiety symptoms on other forms completed. Therefore, the current study examined social anxiety outcomes continuously, inclusive of subthreshold symptoms. Participants were drawn from 40 different clinical groups (18 young adult groups, 22 adolescent groups), conducted between 2008–2017, all in the greater Los Angeles area, within an outpatient clinical setting.

Table 1. Participant demographics.

Measure	n	Percentage	Minimum	Maximum	M	SD
Demographics						
Age (years)						
Adolescents	68	44.2	11.00	17.00	13.94	1.89
Young Adults	86	55.8	18.00	35.00	22.22	3.70
Total Sample	154	100.0	11.00	35.00	18.56	5.12
Gender						
Male	121	78.6				
Female	33	21.4				
Ethnicity						
Caucasian	95	61.7				
Latino/Hispanic	18	11.7				
Asian	18	11.7				
African-American	5	3.2				
Multiracial	12	7.8				
Other	6	3.9				
Baseline Measures						
SAS						
Caregiver-report	139	90.2	20	87	57.94	15.06
Self-report	138	89.6	19	88	53.85	13.32
SRS-2						
Caregiver-report	154	100.0	60	103	75.63	9.98
Post-Treatment Measures						
SAS						
Caregiver-report	117	76.0	20	84	51.25	13.42
Self-report	118	76.6	18	80	48.31	13.96
SRS-2						
Caregiver-report	123	79.9	46	92	66.97	9.66

SAS = Social Anxiety Scale, SRS-2 = Social Responsiveness Scale, 2nd Edition

Procedures

Both PEERS® for Adolescents and PEERS® for Young Adults utilize a small group format (e.g., 10–12 group members), didactic lessons with concrete rules and steps, role play demonstrations, behavioral rehearsals, and weekly socialization assignments to teach ecologically valid social skills. This structure follows CBT tenets through a social skill focused lens. Topics include conversational skills, electronic communication, appropriate use of humor, peer conversation entry and exiting strategies, organizing get-togethers with friends, and handling conflict (i.e., disagreements) and rejection (i.e., bullying). Content examples are adapted to developmentally appropriate normative adolescent and young adult social situations (e.g., high school, clubs, college, workplace); however, the rules and steps of social skills remain standard across the adolescent and young adult programs. Program content unique to the young adult group includes four sessions devoted to dating etiquette, while the adolescent group includes strategies for changing a bad reputation and being a good sport. Additionally, the adolescent program includes "points" to reward participation efforts through a token economy. Both programs require participants attend 90-minute weekly sessions over the course of 16-weeks with a consistent social coach (e.g., caregivers, parents, life coaches). Each week is devoted to content related to making and keeping friends and developing more meaningful friendships/relationships, while social coaches learn how to coach and maintain skill generalization apart from the intervention. Social coaching sessions were led by a licensed clinical psychologist and adolescent/young adult sessions were led by either a licensed clinical psychologist or postdoctoral psychology fellow. Both adolescent and young adult sessions were also supported by a team of undergraduate and graduate psychology students who served as behavioral coaches. Behavioral coaches assisted in tracking treatment fidelity and homework compliance, conducting role-play demonstrations, and providing performance feedback to participants during behavioral rehearsals. Group facilitators and behavioral coaches attended training seminars to be PEERS® certified providers and all members of the treatment team followed

published treatment manual guidelines (Laugeson, 2017; Moody & Laugeson, 2020) and were supervised by the developer of the PEERS® intervention to maintain fidelity.

A battery of measures assessing participants' social behaviors and impairments were administered at two time points to participants and social coaches. Baseline measures were collected prior to intervention and post-assessments were collected immediately upon completing the 16-week intervention. Secondary data analysis of deidentified, archival clinical assessment data was approved by the university's Institutional Review Board.

Measures

Demographic questionnaire

This questionnaire was administered at baseline and includes general information regarding age, gender, ethnic background, diagnoses, education, and medication history.

Social anxiety scale (SAS; la greca, 1998)

The SAS is a 22-item questionnaire that measures levels of social anxiety experienced during social interactions with peers. Each question is rated from 1 to 5 (1 = "not at all," 5 = "all of the time"). The measure yields a total score, with higher scores indicating higher levels of social anxiety. The total score is divided into three subscales: (1) Fear of Negative Evaluation by Peers, (2) Social Avoidance and Distress in New Situations, and (3) Social Avoidance and Distress in General. Numerous studies support the reliability and validity of the SAS-A (for adolescents) in measuring the development of social anxiety (Inderbitzen-Nolan & Walters, 2000; La Greca & Lopez, 1998; Nelemans et al., 2019). Although the SAS was originally developed and normed with adolescent samples, is has been extended to young adults (Chabrol et al., 2017; Garcia-Lopez et al., 2006). The SAS is used widely in ASD samples; initial investigations into the psychometric properties in this population displayed modest support of convergent and divergent validity, with some problems emerging in

comparing caregiver- and self-report (Schiltz et al., 2021). For the current study, the SAS was completed by adolescents, young adults, and caregivers pre- and post-intervention (See Table 1).

Social responsiveness scale, 2nd edition (SRS-2; constantino & gruber, 2012)

The SRS-2 is a 65-item questionnaire that measures traits and symptoms that distinguish behavior indicative of ASD from other behavior variations. Previous research demonstrates the validity and reliability of the SRS-2 as a quantitative measure of core ASD symptoms related to social impairments and challenges in general and in the context of PEERS® groups (Bruni, 2014; Cholemkery et al., 2014). Each question is rated from 1 to 4 (1 = "not true," 4 = "almost always true"). The SRS-2 yields a total T score (M = 50, SD = 10) that indicates normal to autistic behavior and can be broken into the Restricted Interests and Repetitive Behavior Index (RRB) and the Social Communication Index (SCI), the latter of which includes the following subscales: Social Awareness, Social Cognition, Social Communication, Social Motivation (Grzadzinski et al., 2011). Higher scores indicate greater social impairment, with T scores ≥ 60 considered within the clinical range (See Table 1). The SRS-2 was completed by caregivers at pre- and post-intervention to assess treatment outcome related to social responsiveness.

Data analytic plan

Descriptive statistics and preliminary analyses were conducted to explore correlations between variables of interest and variables from different informants. Given findings that SAS caregiver- and self-report may function differently in ASD samples (Schiltz et al., 2021), separate models were conducted using caregiver- and self-reported social anxiety symptoms to fully explore possible relationships. Approximately 26.6% (n = 41) of participants had at least one missing value on the main variables of interest post-intervention. No significant differences were observed between those with and without missing data. Participants were excluded if they were missing data on variables included in the respective model.

To accomplish our first aim, we examined whether baseline social anxiety symptoms predicted treatment response with respect to social responsiveness using a regression in which change on the SRS-2 was predicted by baseline SAS scores, age group (i.e., adolescent or young adult), and their respective interaction. For our second aim, SAS scores at pre- and post-treatment were entered into repeated measures ANOVA, in which age group was also entered as a between-subjects factor. To further explore changes in social anxiety following the PEERS® social skills intervention, we also tested whether presence of clinically elevated social anxiety symptoms at baseline predicted degree of improvement in social anxiety using a 2 × 2 ANOVA with program age group included as well. Finally, for our third aim, we conducted a regression analysis in which change in social anxiety symptoms on the SAS was predicted by change in social responsiveness in the SRS-2, with the moderating effect of age group included.[2] When continuous variables were included in analyses as independent variables, regression models were utilized; if both independent variables were categorical, ANOVAs were employed.

Results

Preliminary analyses

Given that the SRS-2 and SAS both measure facets of difficulties in social relationships or situations, an initial exploration of the relation between social responsiveness, as measured by the SRS-2, and social anxiety, as measured by the SAS, was conducted to ensure these assessments were measuring different constructs. Results indicated adequate divergence, with nonsignificant or weak correlations between social responsiveness and social anxiety as reported by caregivers ($r = .161$, $p = .058$) and participants ($r = .190$, $p = .025$), respectively.

A large proportion of the current sample, 71.2% (caregiver-report) and 67.4% (self-report), fell in the clinically elevated range on the SAS (Total

Score ≥ 50) prior to treatment. Although on average both adolescents and young adults self-reported clinically elevated baseline levels of social anxiety, young adults self-reported significantly greater social anxiety symptoms ($M = 56.3$, $SD = 13.2$) than adolescents ($M = 50.7$, $SD = 13.0$), $t(136) = 2.48$, $p = .014$, $d = 0.43$. Caregivers also viewed adolescents and young adults as experiencing significant social anxiety at baseline. However, contrary to self-reports of social anxiety, caregiver-reports revealed no significant difference in symptom severity between adolescents ($M = 57.6$, $SD = 14.6$) and young adults ($M = 58.2$, $SD = 15.5$), $t(137) = 0.26$, $p > .05$, $d = 0.04$.

For the young adult sample, caregiver- and self-report of social anxiety symptoms were correlated at both baseline, $r = .43$, $p < .001$, and post-treatment, $r = .43$, $p < .001$. Similarly, no significant differences were detected between caregiver- and self-report scores on the SAS, at either baseline, $t(74) = 0.92$, $p > .05$, $d = -0.11$, or post-treatment, $t(65) = 0.27$, $p > .05$, $d = 0.03$. In contrast, less concordance between caregiver- and self-report was observed in the adolescent sample. At baseline, caregiver and adolescent reports of social anxiety were not significantly correlated, $r = .14$, $p > .05$, with caregiver reports producing significantly higher scores on the SAS ($M = 57.9$, $SD = 14.5$) compared to adolescent self-report ($M = 50.8$, $SD = 13.2$), $t(57) = 2.97$, $p = .004$, $d = 0.39$. In contrast, at post-treatment, adolescent- and caregiver-report were significantly correlated, $r = .49$, $p = .001$. Despite this shift, adolescents continued to report significantly fewer social anxiety symptoms on the SAS at post-treatment ($M = 44.4$, $SD = 11.7$) than their caregivers ($M = 50.4$, $SD = 11.5$), $t(47) = 3.46$, $p = .001$, $d = 0.50$.

Anxiety as a predictor of response to social skills training

Overall, significant improvements in social responsiveness on the SRS-2, as rated by caregivers, were observed following the PEERS® programs, $t(122) =$

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[2]Due to the nested nature of participants clustered within multiple treatment groups, we also conducted analyses using multilevel modeling. The multilevel models produced the same pattern of results as single level models. Further, the design effects of our primary outcome variables were all less than 2, a commonly used threshold, above which indicates need for multilevel models to account for within-group variability (Muthén & Satorra, 1995; Peugh, 2010). Given these findings, single level models were utilized and reported for parsimony.

Table 2. Regression tables for models predicting change in SRS-2 over course of PEERS® treatment.
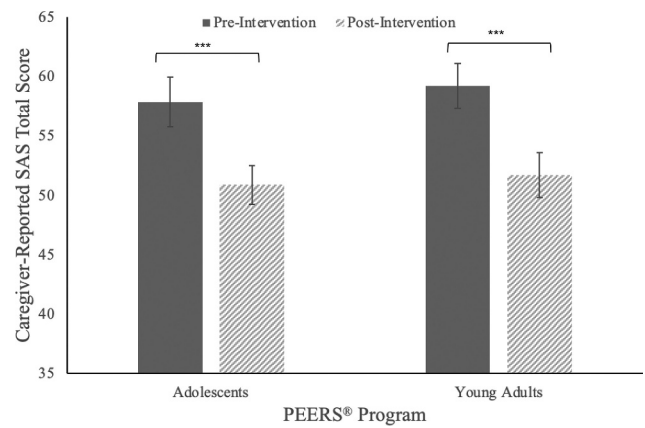
Outcome: SRS-2 Change	B	SE	t	p
Caregiver-Reported Model				
Intercept	−10.32	3.95	−2.61	.010*
Program	−2.87	1.88	−1.53	.130
T1 SAS Total – CG	0.06	0.06	0.99	.327
Program * SAS Total – CG	0.02	0.13	0.17	.866
Self-Reported Model				
Intercept	−12.44	4.13	−3.01	.003**
Program	−2.50	1.88	−1.33	.185
T1 SAS Total – PT	0.10	0.07	1.42	.160
Program * SAS Total – PT	−0.05	0.14	−0.38	.706

Interaction terms were initially tested then removed when non-significant to examine main effects. Program represents age group, referring to whether participant was enrolled in PEERS® for Adolescents or PEERS® for Young Adults. Baseline (T1) Social Anxiety Scale (SAS) Total Scores, whether reported by caregivers or participants, did not significantly predict treatment gains in social responsiveness. *$p < .05$, **$p < .01$, ***$p < .001$.

Figure 1. Change in caregiver-reported social anxiety symptoms, as measured by the social anxiety scale (SAS), following PEERS® social skills training for adolescents and for young adults. *$p < .05$, **$p < .01$, ***$p < .001$.

Figure 2. Change in self-reported social anxiety symptoms, as measured by the social anxiety scale (SAS), following PEERS® social skills training for adolescents and for young adults. *$p < .05$, **$p < .01$, ***$p < .001$.
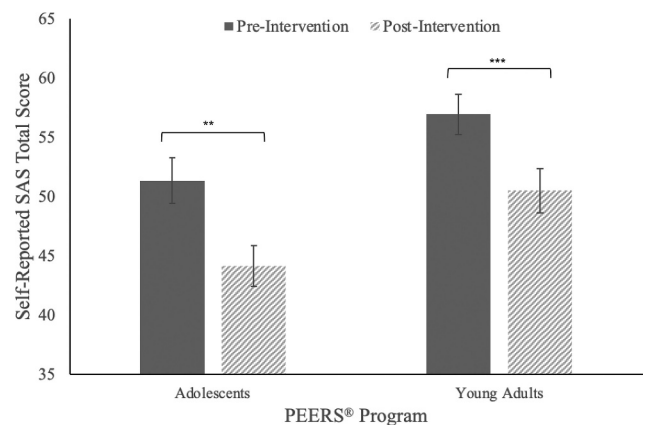
9.30, $p < .001$, $M_{change} = −7.98$, with a large effect size, $d = 0.84$. The regression testing whether baseline caregiver-reported social anxiety predicted change in SRS-2 following PEERS®, and whether this effect was moderated by program age group, was nonsignificant, $F(3,107) = 1.19$, *ns*, $R2 = .03$. The interaction term of this model was nonsignificant, $t(107) = 0.17$, *ns*, indicating that developmental stage did not moderate effects of baseline social anxiety on treatment response. Further, caregiver-reported social anxiety symptoms did not significantly predict change in SRS-2 scores, $t(108) = 0.98$, *ns* (see Table 2). A second model utilizing self-report of social anxiety symptoms at baseline yielded similar results, such that social anxiety prior to treatment did not predict treatment response on the SRS-2, $t(108) = 1.42$, *ns*, for either age group.

Changes in anxiety following social skills training

The repeated measures ANOVA examining change over time in social anxiety symptoms, as measured by the SAS, demonstrated significant improvements following the PEERS® treatment, with large effect sizes, when using both caregiver-report, $F(1,109) = 48.32$, $p < .001$, $\eta_p^2 = 0.31$ (see Figure 1), and self-report, $F(1, 109) = 36.00$, $p < .001$, $\eta_p^2 = 0.25$ (see Figure 2). The degree to which social anxiety symptoms improved was markedly consistent across reporters, with both caregivers and participants showing an approximate 7-point decrease in SAS scores following PEERS® (Parent: $M_{change} =$

−7.3, $SD = 10.8$; Self: $M_{change} = −6.8$, $SD = 11.8$). Further, the interaction between time and program (i.e., adolescent, young adult) was not significant in both models (caregiver-report, $F(1,109) = 0.07$, *ns*, $\eta_p^2 = 0.001$, or self-report, $F(109) = 0.12$, *ns*, $\eta_p^2 = 0.001$).

Using change scores on the SAS as the outcome, presence of clinically elevated social anxiety symptoms (SAS ≥ 50) and program age group were entered into two 2 × 2 ANOVAs. The model utilizing caregiver-report was significant, $F(3,107) = 4.65$, $p = .004$, $\eta_p^2 = 0.12$, with baseline presence of clinically elevated social anxiety symptoms emerging as a significant predictor of change in SAS over treatment, $F(1,107) = 13.08$, $p < .001$, $\eta_p^2 = 0.11$. Program (i.e., adolescent or young adult) did not

significantly moderate this effect or independently predict change in social anxiety symptoms. The direction of this effect indicated that, per caregiver perceptions, those who entered the program with clinically elevated social anxiety symptoms showed significantly greater reductions in social anxiety (caregiver model: estimated M_{change} = −9.46) following the PEERS® social skills training than those who entered with social anxiety symptoms below the clinical cutoff at baseline (caregiver model: estimated M_{change} = −1.45).

The model utilizing self-report was also significant, $F(3,107)$ = 11.51, p < .001, η_p^2 = 0.24; however, a significant interaction between program age group and baseline presence of clinically elevated social anxiety symptoms emerged, $F(1,107)$ = 18.36, p < .001, η_p^2 =0.15. The nature of the interaction suggested that young adults showed similar improvements in social anxiety following the PEERS® intervention, regardless of their self-reported scores on the SAS at baseline (non-clinically elevated estimated M_{change} = −6.41, clinically elevated estimated M_{change} = −6.43). In contrast, adolescents showed a similar pattern to the caregiver-report model, such that adolescents who self-reported higher social anxiety symptoms at baseline showed greater improvements (M_{change} = −13.90) than those in the non-clinically elevated range (M_{change} = 4.59).

Interdependence of anxiety and social functioning outcomes

Multiple regression models were conducted to examine whether improvement in social responsiveness over the course of PEERS® corresponded to improvements in social anxiety (see Table 3). In a manner similar to previous analyses, SRS-2 change scores, program age group (i.e., adolescent or young adult), and their interaction term were entered as explanatory variables into the model. One model utilized change in caregiver-reported social anxiety as the outcome and the other used change in self-reported social anxiety symptoms. Both models indicated that changes in social responsiveness significantly explained variability in changes in social anxiety as reported by caregivers, $t(107)$ = 3.65, p < .001, model R^2 = .11, and participants, $t(104)$ = 2.55, p = .012, model R^2 = .06. The direction of this effect was such that those participants who made greater gains in social responsiveness over the course of treatment also tended to report greater improvements in their social anxiety symptoms. For both caregiver- and self-report models, age did not moderate the relationship between SRS-2 change and SAS change (non-significant interactions), suggesting results were consistent across adolescent and young adult participants.

Discussion

This study aimed to examine how social anxiety moderated treatment response in the context of a social skills intervention, as well as whether such intervention approaches mitigated social anxiety symptoms for autistic individuals. Additionally, the current study examined the role of program age group (i.e., adolescents, young adults) and informant report. Consistent with previous research (Laugeson et al., 2012, 2015), results demonstrated that autistic individuals show improvements in social functioning following the PEERS® program. The current study further demonstrated that these improvements were independent of baseline levels of social anxiety, providing support that PEERS® social skills training may

Table 3. Regression tables for models predicting change in social anxiety symptoms (SAS Total) over course of PEERS® treatment.

Outcome: SAS Change	B	SE	t	p
Caregiver-Reported Model				
Intercept	−5.01	1.49	−3.36	.001**
Program	1.52	2.01	0.76	.451
SRS-2 Change	0.38	0.11	3.65	< .001***
Program * SRS-2 Change	−0.16	0.21	−0.75	.456
Self-Reported Model				
Intercept	−4.57	1.70	−2.64	.010*
Program	0.12	2.26	−0.05	.957
SRS-2 Change	0.30	0.12	2.55	.012*
Program * SRS-2 Change	−0.14	0.24	−0.59	.554

Interaction terms were initially tested then removed when non-significant to examine main effects. Program represents age group, referring to whether participant was enrolled in PEERS® for Adolescents or PEERS® for Young Adults. Changes in social-responsiveness, as measured by the SRS-2, significantly predicted contemporaneous change in social anxiety symptoms, whether reported by caregivers or participants. *p < .05, **p < .01, ***p < .001.

benefit autistic individuals at various ages (e.g., adolescence, adulthood), regardless of baseline social anxiety.

The PEERS® program resulted in significant reductions in social anxiety symptoms, with individuals who presented with clinically elevated baseline levels of social anxiety generally demonstrating significantly greater decreases in anxiety post-treatment. In PEERS®, social interactions are broken into concrete, and actionable steps, which may decrease some anxiety in social situations through reduced ambiguity. Further, behavioral rehearsals within sessions and homework assignments to engage in socialization activities outside of session created opportunities for exposure to social interactions, a known mechanism of change in social anxiety treatment (Barkowski et al., 2016). Additionally, consistent with other studies highlighting the positive impact of including caregivers in interventions (McConachie & Diggle, 2007), caregiver involvement in PEERS® may have bolstered positive outcomes. Caregivers, who served as active social coaches, enabled repeated skills practice in socially safe settings (e.g., between participant and familiar caregiver), potentially mitigating some symptoms of anxiety through numerous opportunities to practice while also increasing social competency. The program is structured to support participants in building toward more challenging exposures or skills in a sequential manner, moving from interacting with caregivers, to peers in the group, followed by peers outside of the group. Caregivers also utilized preparatory and feedback strategies (e.g., priming, prompting, praising, providing corrective feedback and support) to further reinforce gains in social competency; however, such strategies, particularly praise, likely enhanced participants' confidence. Combining the effects of consistent social exposures and caregiver coaching strategies, PEERS® likely served to diminish social anxiety symptoms. As graduated exposures and coaching are common CBT strategies, further comparison between PEERS® and a formal CBT approach is warranted. Though these two approaches share components, social skills training has a more dedicated focus on didactic teaching of concrete social skills, while CBT concentrates heavily on behavioral and cognitive coping strategies.

It is perhaps this unique focus on teaching social rules and steps that may have contributed to the observed benefits. Increased social competence coupled with social engagement may result in a positive feedback loop, in which individuals receive positive reinforcement through increasingly successful social interactions, thus reducing future social anxiety. This hypothesis is supported by findings that indicated changes in social responsiveness were significantly associated with changes in social anxiety, such that individuals who made greater improvement in social responsiveness following the PEERS® intervention also demonstrated more reductions in social anxiety symptoms. This finding may illustrate that social anxiety in individuals on the spectrum is a result of social communication differences characteristic of autism (Postorino et al., 2017), and as such, targeting social skills benefits not only social functioning, but also social anxiety symptoms. However, given the concurrent collection of both autism and anxiety symptoms at only two time points, causality or directionality inferences are unable to be made.

In sum, the PEERS® social skills intervention resulted in significant benefits for adolescents and young adults on the spectrum regarding social responsiveness and social anxiety outcomes. It is necessary to interpret such findings in light of recent research and perspectives in the autism community that social skill interventions may perpetuate a cycle of defining acceptable behavior and support masking or camouflaging (i.e., changing oneself or stifling one's traits to fit into society; e.g., Kapp et al., 2019; Russell et al., 2019). Camouflaging can lead to detrimental long-term effects (e.g., increased suicidality, depression, mental and physical difficulties; S. A. Cassidy et al., 2020; Baldwin & Costley, 2016; Cage et al., 2018; S. Cassidy et al., 2018; Hull et al., 2020; Livingston et al., 2019) in autistic adults. While the authors take this knowledge into serious consideration and applaud reflection within the field, we want to be clear that the goal of PEERS® is not to decrease autistic symptomatology, but rather to teach ecologically valid skills that may be beneficial in navigating the social world for any individual who struggles to make and keep friends. PEERS® emphasizes and encourages autistic individuals to pursue

their interests, find peers accepting of them and with whom they have common interests, and above all, choose how and when to implement skills taught.

In addition, all adolescent and young adult participants are screened for motivation to participate. Only teens and young adults who express a desire to learn skills taught in PEERS® are included, as forcing someone to learn social skills could be seen as unethical. Moreover, the decision to use the skills we teach in PEERS® is a personal choice. The general argument of camouflaging is that teaching social skills to an autistic person is somehow changing who that person is, as if disguising their identity or personality. The focus of PEERS® is not to change the identity of the participants who enter the program, but rather enhance their social interactions so others can appreciate them for who they already are. Nevertheless, using the skills for making and keeping friends and handling conflict and rejection that are the focus of PEERS® is still a personal choice. Yet, research has confirmed that autistic adolescents desire friends and are attuned to experiences of social rejection or exclusion (Cresswell et al., 2019). Further, teens show awareness that social communication differences characteristic of autism contribute to social challenges, and for some, that knowledge makes it difficult to embrace being autistic. It is our firm belief that forcing anyone to participate in a social skills program is unethical, as would denying such interventions to those attempting to decode their social worlds, form meaningful friendships, and asking for help in how to do so. Though not examined in this paper, it may be worthy of note that many clinical participants in PEERS® are not autistic and are also keenly interested in learning skills to make and keep friends, manage peer conflict, and handle bullying. Examining the treatment outcomes and moderators of treatment response among these individuals is recommended for future research.

In examining variation across caregiver- and self-report of social anxiety symptoms, results across informants were largely consistent. Reports of social anxiety symptoms tended to be more similar across informants in young adults, and more discrepant in adolescents. Notably though, correlations between adolescent and caregiver-report increased from pre- to post-treatment, suggesting that the treatment process potentially improved concordance and understanding of symptom presentation within the family; however, future research is needed to conclusively determine if this is an effect of PEERS® or other factors (e.g., pre- and post-intervention sample size differences). Additionally, young adults tended to report more symptoms of social anxiety compared to adolescents. This is consistent with previous research that suggests individuals, especially autistic adolescents, might have difficulty reporting on their own symptoms of anxiety (Adams et al., 2019), and individuals are more attuned to their internalizing emotions as they mature (Van Steensel et al., 2013). Age group was not a moderator of changes in social anxiety symptoms or social responsiveness following intervention, suggesting independent of age, autistic individuals improve on social anxiety when social skills are targeted. Jointly, findings provide evidence for working on social skills at various ages, presenting these skills at a developmentally appropriate level and as a means to target social anxiety as well.

Limitations & future directions

Despite these encouraging findings, there are a number of limitations worth mentioning. First, the present study utilized only two reports of social anxiety (i.e., self and caregiver) and one report of social functioning (i.e., caregiver), with only one measure per construct. Future research might employ multiple assessments and informants, with different modalities across these domains (e.g., additional standardized measures, observational measures of social functioning, independent raters). Recent research has suggested discrepancies in reporting on the SAS between self- and caregiver-report in autistic populations (Schiltz et al., 2021), which will need to be further explored in future studies. Additionally, the lack of comparison group is a limitation and future work may include an active control group to strengthen findings. Finally, selection bias should be considered, as adolescents and young adults in the present study included those motivated to participate in this group modality. Therefore, those too anxious to enroll in a group-based program

might not be represented. Given that data in the current study were collected in the context of clinical service provision, thorough characterization of the sample was not possible. Future research replicating these findings would benefit from additional assessments to confirm ASD diagnosis, cognitive functioning, and treatment history, as well as include data related to attendance and homework completion.

Future work might also examine gender identity, ethnicity and other cultural factors to confirm that social anxiety similarly improves following PEERS® across diverse populations. Additionally, further examination of how PEERS® may confer benefits to other mental health symptomatology beyond social anxiety, such as depression or oppositionality, is warranted. Such investigation would further strengthen the use of social skills interventions to treat mental health problems generally. Another future consideration is to explore the five Research Domain Criteria (RDoC) suggested by the US National Institute of Mental Health (NIMH) and implicated in intervention work for anxiety and ASD (i.e., cognitive systems, negative valence systems, positive valence systems, systems for social processes, and arousal/regulatory systems; White et al., 2018). This could add another layer to exploring the efficacy of PEERS® and provide precision in determining who is most likely to benefit from this treatment. Examining the impact of PEERS® on mental health symptoms in comparison to other intervention approaches for the ASD population (e.g., traditional CBT, mindfulness-based treatments) would also be a fertile future direction. Additionally, examining outcomes longitudinally would bolster these findings, and might serve as a guidepost in the intervention field for treatments focused on social skills, anxiety, ASD symptoms, and caregiver involvement.

Finally, it is essential future work take a more holistic view in examining quality of life, well-being, and ensuring the autistic community feel respected and included. In fact, it has been found that the quality of life is not tied to autistic symptomatology (Bottema-Beutel et al., 2016) and future iterations should instill confidence in one's autistic identity (McConachie et al., 2020).

Conclusions

Overall, this study adds to the burgeoning literature on ASD and anxiety and explores these constructs within the context of a social skills intervention. Results indicate that teaching ecologically valid social skills within a caregiver-assisted intervention both decreases social anxiety and increases social skills for autistic adolescents and young adults. Further, individuals with clinically elevated social anxiety symptoms often showed larger reductions in social anxiety than those without clinically elevated social anxiety symptoms. Through explicitly decoding social situations and creating opportunities for social exposures with coaching feedback, PEERS® may enhance social competence and self-efficacy, while reducing social anxiety symptoms and incidents of social rejection for individuals with ASD. Thus, this program may have a dual benefit of improving core social challenges related to ASD, while also improving co-occurring anxiety symptoms. Identification of interventions with benefits across multiple domains is essential to maximize cost-effectiveness for both service systems and autistic individuals. Widespread implementation of PEERS® is also feasible, augmented by the availability of published manuals detailing treatment administration, as well as additional training resources (e.g., seminars, role play videos) to support fidelity across providers. Taken together, these features strengthen the promise of PEERS® as an alternative treatment approach to address social anxiety symptoms in autistic individuals. Findings have important implications for treatment planning for practitioners, families, and stakeholders.

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