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## The Impact of Co-occurring ADHD on Social Competence Intervention Outcomes in Youth with Autism Spectrum Disorder

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### Abstract

**Purpose:** The co-occurrence of autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) is significant and associated with a host of negative outcomes. Studies investigating social functioning in the presence of the ASD/ADHD co-occurrence have produced mixed findings. The present study further evaluated the impact of co-occurring ADHD on social functioning among youth with ASD and compared treatment response to a social competence intervention between youth with ASD and ASD + ADHD.

**Methods:** Two-way repeated measures analyses of variance (ANOVAs) were computed with diagnostic group and time as the independent variables and measures of social functioning as dependent variables. Group and Time effects and Group by Time interactions were examined.

**Results:** Youth with co-occurring ADHD displayed more impairments related to social awareness, but not in other social areas. Participants in both the ASD and ASD + ADHD groups demonstrated significant improvement following a social competence intervention.

**Conclusion:** Co-occurring ADHD did not negatively affect treatment response. Youth with ASD + ADHD may benefit highly structured interventions with a scaffolded teaching design.

### Keywords

autism; ASD; ADHD; social intervention; social competence

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Difficulties with social interaction and social communication are core diagnostic features of autism spectrum disorder (ASD) and are often the primary target of intervention efforts. Social problems are also relatively common in attention deficit/hyperactivity disorder (ADHD; Kern et al., 2015), and it is estimated that 37 to 85 % of youth with ASD meet criteria for ADHD (Lecavalier et al., 2018; Murray, 2010; Simonoff et al., 2008). It has been suggested that that youth with ASD + ADHD may be less responsive to standard treatments approaches (Leitner, 2014), as the co-occurrence is associated with greater cognitive delays

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(Rao & Landa, 2014), behavior challenges (Guttmann-Steinmetz et al., 2009), and social problems (Factor et al., 2017; McVey et al., 2018) than ASD alone. However, studies of psychosocial interventions amidst the ASD/ADHD co-occurrence are sorely lacking, and there may be important treatment implications for those with potentially compounded social behavioral difficulties.

## Social Impact of the ASD/ADHD Co-occurrence

Studies comparing individuals with ASD + ADHD to those with only one of these diagnoses have suggested that they display greater social problems, though findings have been mixed and marked by inconsistencies in participants characteristics and measurement approaches (Harkins et al., 2021). Several studies employing the parent-report Social Responsiveness Scale (SRS; Constantino et al., 2003; Constantino & Gruber, 2012) as a measure of social impairment have found significant differences between youth with ASD + ADHD and those with either ASD or ADHD alone. One study of young children with the ASD/ADHD co-occurrence indicated greater social impairment across all SRS subscales (Rao & Landa, 2014), while another study of children and adolescents ( $M_{age} = 7.9$  years) revealed that co-occurring ADHD was associated with greater impairments on only the Social Awareness and Social Communication subscales (Factor et al., 2017). Studies relying on the clinician-reported ADOS social domain score as a measure of social impairment have similarly yielded mixed findings. While one study found that the ASD group had significantly greater social impairment than the ASD + ADHD group (Salley et al., 2015), another yielded no significant difference (Harkins et al., 2021). These contrasting findings may be attributed to measurement differences. Studies have shown that the SRS is sensitive (Moul et al., 2015), but not specific, and may be susceptible to symptoms of ADHD (Hus et al., 2013; Sprenger et al., 2013). Additionally, it is possible that the ADOS is sensitive to core symptoms of ASD, but not the qualitative social differences that may be attributed to the co-occurrence of ASD and ADHD (Harkins et al., 2021).

Notably, the ASD + ADHD group in all the aforementioned studies was determined by parent-reported clinically significant ADHD symptoms, rather than a diagnosis of ADHD. Two studies that evaluated social impairment associated with the ASD/ADHD co-occurrence based on diagnosis did not find significant differences between the ASD and ASD + ADHD groups on the SRS (Dellapiazza et al., 2021; Ng et al., 2021) or the ADOS social affect raw score (Ng et al., 2021). The differences in findings between studies that relied on a symptom threshold versus a clinical diagnosis are interesting and warrant further investigation. To address this, the present study will compare social impairment in youth with ASD with and without co-occurring ADHD using multiple measures of social impairment, with group status based on clinical diagnosis.

## Social Skills Interventions for Youth with ASD + ADHD

Despite the high co-occurrence of ASD and ADHD and potential for more severe symptoms, no known manualized psychosocial interventions have been developed for individuals with ASD and ADHD. While many group social interventions designed for ASD are advertised as appropriate for ADHD, few have been evaluated in ADHD (see Willis et al., 2019 for

review of social skills interventions for ADHD), and even fewer have been evaluated for youth with ASD + ADHD (Batson et al., 2017). Thus, it is difficult to discern which social interventions may be most effective for youth affected by the ASD + ADHD, and how co-occurring ADHD impacts treatment outcomes.

One factor that contributes to this difficulty is the lack of reporting of co-occurring psychiatric diagnoses in social interventions studies. A recent systematic review and meta-analysis of group social interventions for ASD included eight studies (Wolstencroft et al., 2018) and not one of them reported on co-occurring disorders within their samples. A review of participant characteristics for articles included in another systematic review and meta-analysis of the UCLA PEERS Program (Zheng et al., 2021) revealed that only three (Hill et al., 2017; Laugeson et al., 2012; Matthews et al., 2018) of the 12 included studies reported co-occurring conditions, including ADHD. As 63–78% of individuals with ASD have at least one co-occurring psychiatric condition (Simonoff et al., 2008), exclusions of this nature may limit understanding of how co-occurring conditions are related to treatment outcomes.

### **Impact of ADHD on Social Skills Int for ASD**

There is little research on the impact of co-occurring ADHD symptoms on treatment outcomes among youth with autism. It is possible that inattention interferes with learning of social skills, hyperactivity disrupts participation in group intervention, and impulsivity hinders application of the acquired abilities in context (Barkley, 1997; Deckers et al., 2016). Only two studies have investigated social treatment gains in the context of the ASD/ADHD co-occurrence.

Antshel and colleagues (2011) investigated the impact of psychiatric comorbidity (i.e., anxiety and ADHD) on social treatment outcomes for clinically-referred children age 8–12 with ASD without intellectual disability (ID). The manualized 10-session 60-minute group social intervention was based on a social adjustment enhancement intervention (described in Solomon et al., 2004) and included children with ASD ( $n = 21$ ), ASD + Anxiety ( $n = 37$ ), and ASD + ADHD ( $n = 25$ ) with average cognitive abilities. Co-occurring disorders were assessed using the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) and a clinical interview. The Social Skills Rating System (SSRS; Gresham & Elliott, 1990) results showed that the ASD and ASD + Anxiety groups both showed significant improvement on the SSRS total score and on the Cooperation and Responsibility subscales. The ASD + ADHD group did not show improvement and were rated as somewhat worse as a function of time on the SSRS. The finding that the ASD + ADHD group did not improve like the other treatment groups is interesting, particularly considering that 72% of children with co-occurring ADHD were on medication and receiving concurrent school-based social skills training (32%) or individual therapy (32%). It is possible that the children with ASD + ADHD could not generalize skills or employ what they learned in context due to worse executive functioning skills or interfering symptoms of ADHD.

Another study by Deckers and colleagues (2016) evaluated the effectiveness of group social skills training delivered in a naturalistic setting for 26 children age 8–12 with ASD without

ID. The manualized social skills training (described in Deckers et al., 2013) consisted of 12 weekly treatment sessions and three parent sessions over the course of the intervention. Each group consisted of four children and treatment involved child and parent workbooks, personalized goals, and weekly homework activities. The primary outcome measure was the social skills observation (SSO; Barry et al., 2003), which was completed by both parents and teachers. ADHD symptoms were a hypothesized moderator, among other variables, and were assessed via the ADHD questionnaire (ADHD-Q; Scholte & Van der Ploeg, 1998). Results indicate that children's social skills significantly improved as a function of treatment per parent-and teacher-report as compared to the waitlist control group. Interestingly, ADHD symptoms did not have an effect on the change in teacher- or parent-reported social skills. It is possible that the participants recruited from a community mental health center presented with milder social impairments and/or milder symptoms of ADHD. The majority of children in the treatment condition (19 of 26) were in the general education setting and 11 of the 26 children were on ADHD medication. Additionally, the highly structured nature of the program, personalized treatment plan, and parent component may have bolstered treatment effects.

Findings regarding the impact of co-occurring ADHD on treatment outcomes for youth with ASD are mixed and limited. Both of the aforementioned studies used one measure of social functioning, which was parent and/or teacher report. Additionally, neither of the studies reported on comparisons of baseline social impairment for the ASD and ASD + ADHD groups. The present study seeks to address these shortcomings and evaluate the impact of the ASD/ADHD co-occurrence on social functioning and social treatment outcomes using a multi-measure, multi-informant approach. It is hypothesized that the ASD and ASD + ADHD groups will be comparable in level of social impairment on parent- and clinician-reported measures of social impairment at baseline, and that the ASD + ADHD group will demonstrate less improvement in social functioning compared to the ASD group following a social competence intervention.

## Methods

### Participants and Procedures

Data were utilized from a previously completed study focused on [BLINDED FOR REVIEW]. All participants had a previous professional diagnosis of ASD confirmed for eligibility in the study by a score at or above the clinical cut-off on the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2; Lord et al., 2012), a full scale IQ or 75 or higher on the Differential Ability Scales, Second Edition (Elliot, 2007), and completed the social competence intervention. This resulted in a sample of 81 children and adolescents (age 6–14).

Participants completed baseline assessments within four weeks of the first treatment session. Post-treatment assessments were collected within two weeks of the last session.

## Treatment

The Social Competence Intervention (SCI) is a group-based manualized intervention designed for youth with ASD without ID that combines cognitive-behavioral and applied behavior analysis principles (Stichter et al., 2010). The SCI aims to address deficits in social perspective taking, emotion recognition, and executive functioning by teaching strategies to shift thinking patterns and by providing appropriate replacement skills (Stichter et al., 2010, 2012; Stichter, Herzog, et al., 2016). There are three versions of the SCI based on age of participants. The Elementary (SCI-E) and Adolescent (SCI-A) curricula include the following units taught in two-week increments: (a) recognizing facial expressions, (b) sharing ideas, (c) turn taking in conversations, (d) recognizing emotions in self and others, and (e) problem solving. Units follow a consistent structure of (a) reviewing a previously learned skill and introducing a new skill, (b) skill modeling, (c) structured and naturalistic practice, and (d) a closing activity or review (Stichter et al., 2010, 2012; Stichter, Herzog, et al., 2016).

Prior research has shown the SCI to be effective in improving social behavior, social interaction, and social cognition in autistic youth (Stichter et al., 2010, 2012; Stichter, Herzog, et al., 2016). Additionally, a prior SCI study found improvements on measures of executive functioning (Stichter, Christ, et al., 2016). In the present study, the SCI spanned an average of 15 weeks and the SCI-E and SCI-A were delivered based on age.

## Measures

### Demographics and History

Parents of participants provided demographic information, including the child's age, gender, race and ethnicity, educational placement, and parental education and household income. They also provided clinical information, including diagnostic history and current medications.

### Clinical Characterization

Cognitive ability was assessed using the Differential Ability Scales, Second Edition (Elliot, 2007). Verbal and Nonverbal Composite scores and Full Scale IQ scores were obtained for all participants. Previous professional diagnosis of ADHD was parent-reported and used to determine diagnostic group status (i.e., ASD or ASD + ADHD). The Hyperactivity/Noncompliance subscale from the Aberrant Behavior Checklist (ABC; Aman & Singh, 1986) was used as a confirmatory measure of ADHD symptoms, and the ASD and ASD + ADHD groups were compared on this subscale at baseline. The ABC is a 58-item caregiver-report questionnaire that measures current behavioral functioning. It has shown strong psychometric properties (Aman et al., 1995) and is widely used in individuals with ASD (Bagaiolo et al., 2019; Sannar et al., 2018). The Hyperactivity/Noncompliance subscale has strong convergent validity with the Behavioral Regulation Index and Global Executive Composite of the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000) and has been shown to predict ADHD diagnostic status (Halvorsen et al., 2019). This subscale also has strong convergent validity with the Attention Problems and ADHD Problems scales on the Child Behavior Checklist among youth with ASD (Kaat

et al., 2014), and has been employed as a primary outcome measure in clinical trials for medication targeting ADHD symptoms in youth with ASD (Mansour et al., 2017; Scahill et al., 2017). Three participants (8.11%) in the ASD group and 32 participants (72.73%) in the ASD + ADHD group were on medication for ADHD symptoms throughout the study. Three participants in the ASD + ADHD group experienced a medication change for ADHD symptoms (i.e., from one ADHD medication to another), but medication use was stable for all other participants.

### Social Functioning

Social functioning was assessed using a variety of measures and informants. The ADOS-2 Social Affect Calibrated Severity Score (ADOS-SA-CSS; Esler et al., 2015; Gotham, Pickles, & Lord, 2009; Hus & Lord, 2014) served as a clinical observational method of social impairment. The ADOS-2 is a standardized, semi-structured assessment of communication and social interaction, and repetitive behaviors and restricted interests. (Lord et al., 2012), and was administered by research-reliable assessors in the current study. The ADOS-SA-CSS is based on a 10-point scale: scores from 1 to 3 are in the “Nonspectrum” range; 4–5 are in the “ASD” range; and 6–10 in the “Autism” range. The CSS severity metric was found to have more uniform distributions across developmental groups than raw scores and to be less influenced by child characteristics such as verbal IQ, nonverbal IQ, age, and race (Gotham et al. 2009; Hus & Lord, 2014).

The Social Responsiveness Scale (SRS-2; Constantino & Gruber, 2012) served as a parent-report measure of social functioning. The SRS-2 is a 65-item questionnaire that generates an overall Total T-Score of autism symptom severity, and subscales for Social Awareness, Social Cognition, Social Communication, and Social Motivation. The SRS-2 has good construct validity (Constantino et al. 2003) and strong reliability (Constantino and Gruber 2005), with a coefficient alpha of 0.95.

The Pediatric Quality of Life Inventory (PedsQL) Version 4.0 (Varni et al., 2001) was administered as an additional measure of social functioning. The PedsQL assesses core dimensions of quality of life and includes 21 items rated on a 5-point scale ranging from 0 (“never a problem”) to 4 (“almost always a problem”). The PedsQL, is a parent-report measure that has been widely used in autism research, and has good reliability and validity (Varni et al., 2001). The Social Functioning Domain Score was used to measure peer and social functioning.

The Autism Impact Measure (AIM) was included to measure the impact of social symptoms on functioning. The AIM is a parent-report questionnaire consisting of 41 items assessing core ASD symptoms. Each item is rated on corresponding 5-point scales for frequency and impact. Frequency ratings reflect how often the behavior has occurred over the past 2 weeks (ranging from “never” to “always”). Impact ratings reflect the degree to which the behaviors or skill deficits have interfered with everyday functioning (ranging from “not at all” to “severely”). Five empirically derived subdomain scores are generated using a subset of 29 items: Repetitive Behavior, Atypical Behavior, Communication, Social Reciprocity, and Peer Interaction (Mazurek, Carlson, Baker-Ericzén, Butter, Norris, & Kanne, 2020). The AIM has demonstrated strong reliability, validity, and sensitivity to change (Houghton



et al., 2019; Kanne et al., 2014; Mazurek, Carlson, Baker-Ericzén, Butter, Norris, & Kanne, 2020; Mazurek, Carlson, Baker-Ericzén, Butter, Norris, Barr, et al., 2020). The Communication, Social Reciprocity, and Peer Interaction subscales were used as measures of social functioning in the present study.

## Analytic Plan

All data were cleaned and examined for outliers, missing data, and distributional assumptions using SPSS Statistics Software, Version 28. Multiple imputation was performed to replace missing data at post-testing (16% missing for all study measures). As the probability of missing data was related to other observed variables, they were assumed to be missing at random and five imputation data sets were used. Descriptive statistics were generated (See Table 1) and bivariate analyses were performed to compare diagnostic groups at baseline. Co-occurring psychiatric disorders for participants are presented in Table 2 and correlations among study variables are presented in Table 3. Two-way repeated measures analyses of variance (ANOVAs) were computed with diagnostic group and time as the independent variables and measures of social functioning as dependent variables. Analysis of covariance (ANCOVA) was employed if significant group differences were observed on variables of interest at baseline, with diagnostic group status as the independent variable, baseline score as the covariate, and the post-intervention score as the dependent variable. Measures of social functioning included the ADOS-SA-CSS, SRS-2 Total T-score, SRS-2 Social Awareness T-score, SRS-2 Social Cognition T-score, SRS-2 Social Motivation T-score, PedsQL Social Functioning Domain score, and the AIM Communication, AIM Social Reciprocity, and AIM Peer Interaction subscale scores. Group and Time effects and Group by Time interactions were examined. In assuming a conservative approach, Bonferroni corrections were applied for all pre-post analyses and an alpha level of 0.017 was set for statistical significance.

## Results

### Baseline Group Comparisons

Diagnostic groups were compared on participant age, gender, ethnicity, race, household income, and IQ. Independent samples t-tests were performed for age and IQ comparisons. Due to small cell sizes, Fisher's exact test was employed to compare groups by gender and ethnicity, and likelihood ratio tests were conducted to compare groups by race and household income. As diagnostic groups did not significantly differ in age ( $t(79) = -2.42, p = 0.07$ ), gender ( $p = 0.72$ ), ethnicity ( $p = 0.71$ ), race ( $p = 0.18$ ), household income ( $p = 0.09$ ), or IQ ( $t(79) = 0.41, p = 0.54$ ) these variables were not included as covariates in subsequent analyses. The ASD and ASD + ADHD groups were compared on baseline ADHD symptoms using the ABC Hyperactivity/Noncompliance subscale score. As expected, the ASD + ADHD group displayed greater symptoms associated with ADHD on average,  $t(79) = 0.4, p = 0.01$ , compared to the ASD group.

Independent samples t-tests were performed to compare the ASD and ASD + ADHD groups on all measures of social functioning at baseline. Results indicated significant group differences on the ADOS-SA-CSS,  $t(79) = 5.80, p < 0.001$ , with the ASD group

demonstrating more social impairment on average than the ASD + ADHD group. Significant differences were also observed on the SRS-2 Social Awareness T-score,  $t(79) = -2.29$ ,  $p = 0.03$ , with the ASD + ADHD group having higher scores, indicating more difficulties on average than the ASD group. No significant differences were observed for any other SRS-2 subscale or the SRS-2 Total T-score, any of the AIM subscales, or the PedsQL Social Domain score (See Table 4).

### Time and Group Effects

Analyses were performed to compare the effects of time and diagnostic group status and on all measures of social functioning. Two-way repeated measures ANOVAs were conducted for most study measures (i.e., AIM subscales, PedsQL Social Domain, SRS-2 Total and Social Communication, Cognition, and Motivation subscales). ANCOVAs were performed for the two study measures that diagnostic groups significantly differed on at baseline assessment (i.e., ADOS-SA-CSS, SRS-2 Social Awareness).

Significant main effects of time were observed, but no significant group effects or interactions between time and diagnostic group were observed. Time effects are presented in Figure 1. There was a significant main effect of time observed on all AIM subscales, including Communication,  $F(1,79) = 22.84$ ,  $p < .001$ , Social Reciprocity,  $F(1,79) = 7.31$ ,  $p = .008$ , and Peer Interaction,  $F(1,79) = 23.87$ ,  $p < .001$ ; scores were significantly lower, indicating symptom improvement following participation in SCI. The main effect of time was also significant for the SRS-2 Total T-Score,  $F(1,79) = 25.00$ ,  $p < .001$ , and all social subscales, including Social Awareness,  $F(1,79) = 10.80$ ,  $p < .001$ , Social Cognition,  $F(1,79) = 12.99$ ,  $p < .001$ , Social Communication,  $F(1,79) = 20.71$ ,  $p < .001$ , and Social Motivation,  $F(1,79) = 23.87$ ,  $p < .001$ . Scores were significantly lower, indicating symptom improvement following participation in SCI. No significant main effect of time was observed on the ADOS-SA-CSS ( $F = 0.09$ ,  $p = .77$ ) or PedsQL Social Domain ( $F = 4.72$ ,  $p = .03$ ).

No main effects of diagnostic group were observed for the ADOS-SA-CSS ( $F = 0.03$ ,  $p = .87$ ), AIM Communication subscale ( $F = 0.004$ ,  $p = 0.95$ ), AIM Social Reciprocity subscale ( $F = 0.15$ ,  $p = .70$ ), AIM Peer Interaction subscale ( $F = 2.39$ ,  $p = .13$ ), SRS-2 Total T-score ( $F = 4.58$ ,  $p = .04$ ), SRS-2 Social Awareness subscale ( $F = 0.85$ ,  $p = .36$ ), SRS-2 Social Communication ( $F = 3.89$ ,  $p = .05$ ), SRS-2 Social Cognition subscale ( $F = 1.41$ ,  $p = .24$ ), SRS-2 Social Motivation subscale ( $F = 1.36$ ,  $p = .25$ ), or PedsQL Social Domain score ( $F = 0.17$ ,  $p = .68$ ) at the set significance level.

### Discussion

This study sought to further explore the impact of the co-occurrence of ASD and ADHD on social functioning and determine if youth with ASD and ASD + ADHD demonstrate similar treatment gains following a social competence intervention. Contrary to our hypothesis, significant differences were observed between the ASD and ASD + ADHD groups at baseline on two measures, the ADOS-SA-CSS and SRS-2 Social Awareness subscale. The ASD group displayed greater social impairment than the ASD + ADHD group on the ADOS-SA-CSS, consistent with results found by Salley and colleagues (2015), but inconsistent with results found by Harkins and colleagues (2021) that revealed no



differences between these diagnostic groups. Such discrepancies likely reflect differences in sample characteristics. Notably, our sample was restricted by age (6–14;  $M$  age = 10.8 years) and IQ ( $M = 75$ ) and may represent an older group with fewer functional limitations compared to the sample reported by Harkins and colleagues (2021). Their clinically-referred sample had lower cognitive abilities ( $MIQ$  for ASD group = 73.13 and ASD + ADHD group = 86.99), younger age ( $M = 7.76$ ), and more social and behavioral difficulties, which could explain the lack of significant group differences.

The finding that the ASD + ADHD group demonstrated more impairment on the SRS-2 Social Awareness subscale than the ASD group is consistent with results by Factor and colleagues (2017). Items within the Social Awareness subscale assess an individual's ability to focus attention to where others are looking/listening and notice when they are making too much noise or interfering with others' conversation. It is perhaps unsurprising that youth with co-occurring ADHD displayed more impairment, as social awareness requires that one attend to the environment, other people, and to how one's behavior affects other people in that environment.

As expected, the ASD and ASD + ADHD groups presented similarly on measures of global social functioning (i.e., SRS-2 Total, PedsQL Social Domain) and specific social symptoms of ASD (i.e., SRS and AIM subscales) at baseline. The lack of significant group differences on the SRS-2 Total and most subscales is consistent with prior studies (Dellapiazza et al., 2021; Factor et al., 2017; McVey et al., 2018). Additionally, the ASD and ASD + ADHD groups scored similarly on the AIM Communication, Social Reciprocity, and Peer Interaction subscales, which suggests ADHD symptoms did not exacerbate the core symptoms assessed.

In the present study, youth with ASD and ASD + ADHD participated in a 15-week intervention focused on social competence (Stichter et al., 2010). Following the SCI, participants in both groups showed improvement on most measures of social functioning. Improvements were observed on the AIM Communication, Peer Interaction, and Social Reciprocity subscales, the SRS-2 Total Score and all social subscales (e.g., Awareness, Cognition, Communication, and Motivation). The social gains align with the curricular constructs of the SCI and prior research (Stichter et al., 2010, 2012; Stichter, Christ, et al., 2016; Stichter, Herzog, et al., 2016). Interestingly, significant improvements were not observed on the PedsQL Social Domain. This five-item scale measures social acceptance (e.g., being liked by peers, getting along with peers), social rejection (e.g., being teased by peers), and age-appropriate social behavior (e.g., keeping up during play). It is possible that social gains made during the SCI did not necessarily result in greater peer acceptance or decreased peer rejection at the time of post-testing. A longitudinal study found that youth with ASD with stronger social skills and fewer autistic characteristics experienced increased peer acceptance from one year to the next, while those with poorer social skills and greater autism symptoms experienced greater social rejection over time (Feldman et al., 2022). This supports the idea that peer acceptance is driven in part by an individual's social competence, and can be improved over time (Santillan et al., 2019). Thus, it is possible that 15 weeks was not enough time for participants in this SCI study to demonstrate improved peer relationships on the PedsQL Social Domain. Further, while the SCI targets theory of

mind and social communication, it does not explicitly address externalizing behaviors and repetitive and restricted interests/behaviors, which have been associated with decreased peer acceptance and increased social rejection (de Boer & Pijl, 2016; Rubin et al., 2006). Further, significant improvements were not observed on the ADOS-SA, which is unsurprising as this diagnostic tool was designed to determine categorical presence or absence of autism, but not to be sensitive to short-term change across relatively brief intervals.

The finding that participants in both diagnostic groups showed significant improvement on several measures of social functioning is promising and lends support to the effectiveness of the SCI for youth with ASD and co-occurring ADHD. Our results are in line with those of Deckers and colleagues (2016), who found that that ADHD symptoms did not moderate social gains following a similar intervention. Notably, their intervention included a heavy parent component, wrap around support, and individualized feedback, which may have aided skill acquisition, maintenance, and generalization for participants with ADHD symptoms. Deckers and colleagues did not compare social treatment gains between youth with ASD and ASD and clinically-diagnosed ADHD, perhaps due to small sample sizes.

This is one of only two studies to date to compare social skills treatment gains among youth with ASD as compared to those with ASD + ADHD. The first, by Antshel and colleagues (2011), found that youth with ASD showed improvement on the SSRS Total and the Assertion, Cooperation, and Responsibility subscales, while those with co-occurring ADHD did not. While the present study is similar to that of Antshel and colleagues (2011) in regard to intervention components and sample characteristics, there are noteworthy differences that may clarify differences in findings. The skill areas targeted by intervention are similar (e.g., emotion recognition, conversation skills, social problem solving), but the scaffolded teaching design and ongoing practice of recurring concepts is unique to the SCI. This structure and repetition may benefit participants with ADHD, as the SCI has been shown to improve certain executive functions, including the ability to attend, recall, monitor and inhibit responses, and apply rules to problems (Stichter, Christ, et al., 2016). The SCI is also five weeks longer than the intervention used by Antshel and colleagues, so the additional time on concepts and opportunities for practice and feedback may be helpful for youth with ASD and ADHD.

Measurement differences may also explain differences in findings. The SSRS, used by Antshel and colleagues, contains 55 questions that fall into two domains, Social Skills and Problem Behaviors. The Social Skills domain includes 38 items and comprises the Cooperation, Assertion, Responsibility, and Self-Control subscales that assess social skills in the home and community setting. The remaining 17 items assess behavioral difficulties, and scores in both the Social Skills and Problem Behaviors domains are combined to generate the total score. As a third of the items that compose the SRSS total score assess behaviors that map onto core symptoms of ADHD, it may be unsurprising that individuals with ASD and co-occurring ADHD demonstrate more impairment, and perhaps less improvement following intervention on this measure. Additionally, symptoms of inattention and hyperactivity/impulsivity have been associated with worse performance on the Cooperation, Assertion, Responsibility, and Self-Control subscales in a study of youth with ADHD (Van Der Oord et al., 2005).

This study contributes to the growing body of research on the co-occurrence of ASD and ADHD. A primary aim of this study was to compare social functioning between youth with ASD and ASD + ADHD in efforts to reconcile the mixed findings that characterize the literature. The finding by Factor and colleagues (2017) that youth with ASD + ADHD display compounded difficulties with social awareness was replicated. Our results contribute to mixed findings regarding the ADOS-SA-CSS amid the co-occurrence of ASD and ADHD, and suggest that differences in sample characteristics contribute to mixed findings. Another aim of this study was to compare treatment response to a social skills intervention in youth with ASD with and without co-occurring ADHD. Findings suggest the SCI is associated with significant social gains and is effective for youth with ASD even in the presence of co-occurring ADHD.

### Limitations and Future Directions

There are several limitations related to measurement, study design, and sample characteristics. This study assessed social functioning using several measures designed or validated for individuals with ASD. However, the study lacked multi-rater or direct measures that may have yielded more comprehensive information about social functioning across contexts. Additionally, it may have been informative to ask youth with ASD and ASD + ADHD about their perceived social abilities, social relationships, and barriers to social performance. Further, the present study would have been strengthened by inclusion of a more comprehensive, specific measure of ADHD symptoms. The ABC Hyperactivity/Noncompliance subscale was used as a measure of ADHD symptoms, and to confirm that the clinically-diagnosed group with ASD + ADHD displayed more severe ADHD symptoms. However, more information on ADHD symptoms/subtype and executive functioning would have strengthened the study. Lastly, measures of co-occurring psychiatric symptoms would have allowed for additional analyses. Consistent with prior research indicating that co-occurring ADHD is associated with increased psychiatric symptoms in youth with ASD (Lecavalier et al., 2018; Mansour et al., 2017), the ASD + ADHD group in the current study had more parent-reported psychiatric diagnoses than the ASD group. As co-occurring psychiatric symptoms may contribute to social challenges, and impaired emotional and behavioral regulation, future research on the ASD/ADHD comorbidity may seek to determine how additional psychiatric diagnoses impacts social challenges and social treatment outcomes.

There are also limitations associated with the pre-post study design. Follow-up data were not available and maintenance and generalization data may be important when considering the appropriateness of interventions for youth with co-occurring ADHD. Randomized controlled trials will be necessary to determine the effectiveness of the SCI and to determine which interventions are best suited for youth with ASD + ADHD.

Finally, there are limitations of the present study with regard to the sample. While the sample was relatively large and well-characterized, it was fairly homogenous. The lack of diversity with regard to race and ethnicity is a noteworthy limitation, as normative social behaviors are culturally-bound. As the sample was almost entirely male, and it cannot be assumed that findings would look similar among females. A growing body of research

points to differences in the social presentations and social experiences of males and females with autism without ID (de Giambattista et al., 2021; Sedgewick et al., 2019; Wood-Downie et al., 2021). Future social treatment studies should consider gender in the context of treatment response and group composition. In the current study only a handful of females participated in almost all-male groups; it is unclear how the unbalanced gender composition impacted the treatment experience of participants. Further, as participants in this study had IQ scores at or above 75, findings cannot be generalized to youth with ASD and ID. Individuals with ID and/or significant language concerns may not achieve the same level of gains from the SCI. Additionally, the impact of co-occurring ADHD symptoms on social functioning and treatment response is likely very different among youth with ASD versus ASD + ID. Future studies should explore this, given the growing need for interventions that are accessible for youth with ASD + ID.

In conclusion, additional research is needed to determine which social interventions are most appropriate for youth with ASD + ADHD. Our findings suggest that youth with ASD + ADHD may benefit highly structured interventions with a scaffolded teaching design. It will be important for future psychosocial treatment studies in autism to report co-occurring conditions for participants and evaluate the role these symptoms have on treatment outcomes.

## References

- Achenbach TM, Rescorla L. Manual for the ASEBA school-age forms & profiles: an integrated system of multi-informant assessment Burlington, VT: University of Vermont, Research Center for Children, Youth & Families; 2001.
- Aman M, & Singh N (1986). Aberrant behavior checklist: Manual
- Bagaiolo LF, Bordini D, Cunha G. R. da, Sasaki TND, Nogueira MLM, Pacifico CR, & Braidio M (2019). Implementing a community-based parent training behavioral intervention for Autism Spectrum Disorder. *Psicologia - Teoria e Prática*, 21(3). 10.5935/1980-6906/psicologia.v21n3p456-472
- Barkley RA (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin*, 121(1), 65–94. 10.1037/0033-2909.121.1.65 [PubMed: 9000892]
- Barry TD, Klinger LG, Lee JM, Palardy N, Gilmore T, & Bodin SD (2003). Examining the Effectiveness of an Outpatient Clinic-Based Social Skills Group for High-Functioning Children with Autism. *Journal of Autism and Developmental Disorders*, 33(6), 685–701. 10.1023/B:JADD.0000006004.86556.e0 [PubMed: 14714936]
- Batson M, Elliott S, Lam G, Seimears N, Batson M, & Lam G (2017). Social Skills Interventions for Adolescents with ASD, ADHD, and Other Comorbidities [http://soundideas.pugetsound.edu/ot\\_capstone/24](http://soundideas.pugetsound.edu/ot_capstone/24)
- Constantino J, Constantino JN, Davis SA, Todd RD, Schindler MK, Gross MM, Brophy SL, Metzger LM, Shoushtari CS, Splinter R, & Reich W (2003). Validation of a brief quantitative measure of autistic traits: Comparison of the social responsiveness scale with the autism diagnostic interview-revised. *Journal of Autism and Developmental Disorders*, 33(4), 427–433. 10.1023/A:1025014929212 [PubMed: 12959421]
- de Boer A, & Pijl SJ (2016). The acceptance and rejection of peers with ADHD and ASD in general secondary education. *Journal of Educational Research*, 109(3), 325–332. 10.1080/00220671.2014.958812
- de Giambattista C, Ventura P, Trerotoli P, Margari F, & Margari L (2021). Sex Differences in Autism Spectrum Disorder: Focus on High Functioning Children and Adolescents. *Frontiers in Psychiatry*, 12, 1063. 10.3389/fpsy.2021.539835

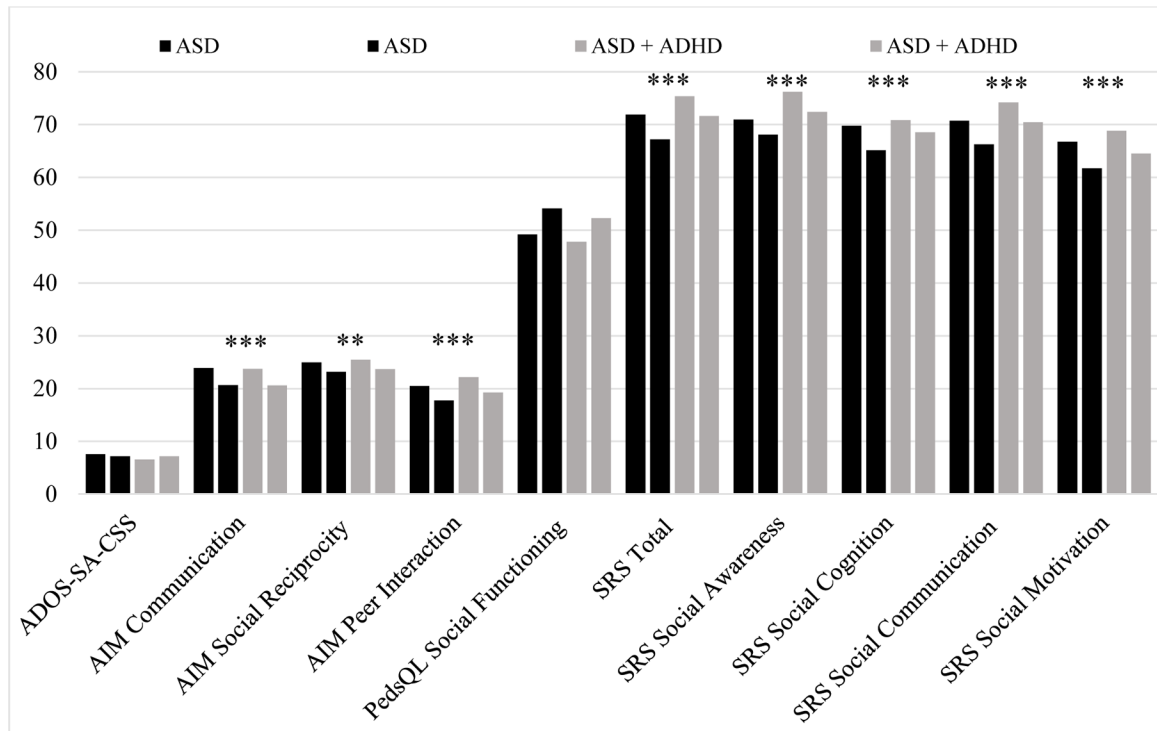
- Deckers A, Muris P, Roelofs J, & Arntz A (2016). A Group-Administered social Skills Training for 8- to 12- Year-Old, high-Functioning Children With Autism Spectrum Disorders: An Evaluation of its Effectiveness in a Naturalistic Outpatient Treatment Setting. *Journal of Autism and Developmental Disorders*, 46(11), 3493. 10.1007/S10803-016-2887-1 [PubMed: 27522220]
- Dellapiazza F, Audras-Torrent L, Michelon C, Baghdadli A, & Baghdadli A (2021). Clinical characteristics of children with ASD and comorbid ADHD: Association with social impairment and externalizing and internalizing behaviours. *Research in Developmental Disabilities*, 113, 103930. 10.1016/j.ridd.2021.103930 [PubMed: 33690105]
- Elliot C (2007). *Differential abilities scale—2nd Edition (DAS-II) manual 2nd ed.*
- Esler AN, Bal VH, Guthrie W, Wetherby A, Weismer SE, & Lord C (2015). The autism diagnostic observation schedule, toddler module: Standardized severity scores. *Journal of Autism and Developmental Disorders*, 45(9), 2704–2720. 10.1007/s10803-015-2432-7 [PubMed: 25832801]
- Factor RS, Ryan SM, Farley JP, Ollendick TH, & Scarpa A (2017). Does the presence of anxiety and ADHD symptoms add to social impairment in children with autism spectrum disorder? *Journal of Autism and Developmental Disorders*, 47(4), 1122–1134. 10.1007/s10803-016-3025-9 [PubMed: 28132125]
- Feldman M, Hamsho N, Blacher J, Carter AS, & Eisenhower A (2022). Predicting peer acceptance and peer rejection for autistic children. *Psychology in the Schools*, 59(11), 2159–2182. 10.1002/pits.22739
- Gotham K, Pickles A, & Lord C (2009). Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders*, 39(5), 693–705. 10.1007/s10803-008-0674-3 [PubMed: 19082876]
- Guttmann-Steinmetz S, Gadow KD, & DeVincent CJ (2009). Oppositional defiant and conduct disorder behaviors in boys with autism spectrum disorder with and without attention-deficit hyperactivity disorder versus several comparison samples. *Journal of Autism and Developmental Disorders*, 39(7), 976–985. 10.1007/s10803-009-0706-7 [PubMed: 19288296]
- Halvorsen M, Aman MG, Mathiassen B, Brøndbo PH, Steinsvik OO, & Martinussen M (2019). Psychometric Properties of the Norwegian Aberrant Behavior Checklist and Diagnostic Relationships in a Neuro-Pediatric Sample. *Journal of Mental Health Research in Intellectual Disabilities*, 12(3–4), 234–255. 10.1080/19315864.2019.1630872
- Harkins CM, Handen BL, & Mazurek MO (2021). The Impact of the Comorbidity of ASD and ADHD on Social Impairment. *Journal of Autism and Developmental Disorders*. 10.1007/s10803-021-05150-1
- Hill TL, Gray SAO, Baker CN, Boggs K, Carey E, Johnson C, Kamps JL, & Enrique Varela R (2017). A Pilot Study Examining the Effectiveness of the PEERS Program on Social Skills and Anxiety in Adolescents with Autism Spectrum Disorder. *Journal of Developmental and Physical Disabilities*, 29(5), 797–808. 10.1007/s10882-017-9557-x [PubMed: 29576723]
- Houghton R, Monz B, Law K, Loss G, Le Scouiller S, de Vries F, & Willgoss T (2019). Psychometric Validation of the Autism Impact Measure (AIM). *Journal of Autism and Developmental Disorders*, 49(6), 2559–2570. 10.1007/s10803-019-04011-2 [PubMed: 30968318]
- Hus V, Bishop S, Gotham K, Huerta M, & Lord C (2013). Factors influencing scores on the social responsiveness scale. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, 54(2), 216–224. 10.1111/j.1469-7610.2012.02589.x [PubMed: 22823182]
- Hus V, & Lord C (2014). The autism diagnostic observation schedule, module 4: Revised algorithm and standardized severity scores. *Journal of Autism and Developmental Disorders*, 44(8), 1996–2012. 10.1007/s10803-014-2080-3 [PubMed: 24590409]
- Kaat AJ, Lecavalier L, & Aman MG (2014). Validity of the aberrant behavior checklist in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 44(5), 1103–1116. 10.1007/s10803-013-1970-0 [PubMed: 24165702]
- Kanne SM, Mazurek MO, Sikora D, Bellando J, Branum-Martin L, Handen B, Katz T, Freedman B, Powell MP, & Warren Z (2014). The autism impact measure (AIM): Initial development of a new tool for treatment outcome measurement. *Journal of Autism and Developmental Disorders*, 44(1), 168–179. 10.1007/s10803-013-1862-3 [PubMed: 23748386]



- Kern JK, Geier DA, Sykes LK, Geier MR, & Deth RC (2015). Are ASD and ADHD a Continuum? A Comparison of Pathophysiological Similarities Between the Disorders. *Journal of Attention Disorders*, 19(9), 805–827. 10.1177/1087054712459886 [PubMed: 23074304]
- Laugeson EA, Frankel F, Gantman A, Dillon AR, & Mogil C (2012). Evidence-based social skills training for adolescents with autism spectrum disorders: The UCLA PEERS program. *Journal of Autism and Developmental Disorders*, 42(6), 1025–1036. 10.1007/s10803-011-1339-1 [PubMed: 21858588]
- Lecavalier L, Mccracken CE, Aman MG, Mcdougale CJ, Mccracken JT, Tierney E, Smith T, Johnson C, King B, Handen B, Swiezy NB, Arnold LE, Bearss K, Vitiello B, & Scahill L (2018). An exploration of concomitant psychiatric disorders in children with autism spectrum disorder 10.1016/j.comppsy.2018.10.012
- Leitner Y (2014). The Co-occurrence of autism and attention deficit hyperactivity disorder in children: What do we know? *Frontiers in Human Neuroscience*, 8(April), 1–8. 10.3389/fnhum.2014.00268 [PubMed: 24474914]
- Lord C, Rutter M, DiLvaore P, Risi S, Gotham K, & Bishop S (2012). Autism diagnostic observation schedule, second edition (ADOS-2) manual (Part 1): Modules 1–4 Western Psychological Services.
- Mansour R, Dovi AT, Lane DM, Loveland KA, & Pearson DA (2017). ADHD severity as it relates to comorbid psychiatric symptomatology in children with Autism Spectrum Disorders (ASD). *Research in Developmental Disabilities*, 60, 52–64. 10.1016/j.ridd.2016.11.009 [PubMed: 27889487]
- Matthews NL, Orr BC, Warriner K, DeCarlo M, Sorensen M, Laflin J, & Smith CJ (2018). Exploring the Effectiveness of a Peer-Mediated Model of the PEERS Curriculum: A Pilot Randomized Control Trial. *Journal of Autism and Developmental Disorders*, 48(7), 2458–2475. 10.1007/s10803-018-3504-2 [PubMed: 29453708]
- Mazurek MO, Carlson C, Baker-Ericzén M, Butter E, Norris M, Barr C, & Kanne S (2020). The Autism Impact Measure (AIM): Examination of Sensitivity to Change. *Autism Research*, 13(11), 1867–1879. 10.1002/aur.2397 [PubMed: 33001561]
- Mazurek MO, Carlson C, Baker-Ericzén M, Butter E, Norris M, & Kanne S (2020). Construct Validity of the Autism Impact Measure (AIM). *Journal of Autism and Developmental Disorders*, 50(7), 2307–2319. 10.1007/s10803-018-3462-8 [PubMed: 29344761]
- McVey AJ, Schiltz HK, Haendel AD, Dolan BK, Willar KS, Pleiss SS, Karst JS, Carlson M, Krueger W, Murphy CC, Casnar CL, Yund B, & Van Hecke AV (2018). Social difficulties in youth with autism with and without anxiety and ADHD symptoms. *Autism Research*, 11(12), 1679–1689. 10.1002/aur.2039 [PubMed: 30475451]
- Moul C, Cauchi A, Hawes DJ, Brennan J, & Dadds MR (2015). Differentiating Autism Spectrum Disorder and Overlapping Psychopathology with a Brief Version of the Social Responsiveness Scale. *Child Psychiatry and Human Development*, 46(1), 108–117. 10.1007/s10578-014-0456-4 [PubMed: 24604214]
- Murray MJ (2010). Attention-deficit/Hyperactivity Disorder in the Context of Autism Spectrum Disorders. *Current Psychiatry Reports* 2010 12:5, 12(5), 382–388. 10.1007/S11920-010-0145-3
- Ng R, Heinrich K, & Hodges E (2021). Associations Between ADHD Subtype Symptomatology and Social Functioning in Children With ADHD, Autism Spectrum Disorder, and Comorbid Diagnosis: Utility of Diagnostic Tools in Treatment Considerations. *Journal of Attention Disorders*, 25(6), 820–828. 10.1177/1087054719855680 [PubMed: 31200611]
- Rao PA, & Landa RJ (2014). Association between severity of behavioral phenotype and comorbid attention deficit hyperactivity disorder symptoms in children with autism spectrum disorders. *Autism*, 18(3), 272–280. 10.1177/1362361312470494 [PubMed: 23739542]
- Salley B, Gabrielli J, Smith CM, & Braun M (2015). Do communication and social interaction skills differ across youth diagnosed with autism spectrum disorder, attention-deficit/hyperactivity disorder, or dual diagnosis? *Research in Autism Spectrum Disorders*, 20, 58–66. 10.1016/j.rasd.2015.08.006 [PubMed: 26779281]
- Sannar EM, Palka T, Beresford C, Peura C, Kaplan D, Verdi M, Siegel M, Kaplan S, Grados M, Erickson C, Gabriels RL, Mazefsky C, Morrow EM, Righi G, Santangelo SL, Wink L, Benevides J, Best C, Bowen K, ... Williams D (2018). Sleep Problems and Their Relationship



- to Maladaptive Behavior Severity in Psychiatrically Hospitalized Children with Autism Spectrum Disorder (ASD). *Journal of Autism and Developmental Disorders*, 48(11), 3720–3726. 10.1007/s10803-017-3362-3 [PubMed: 29086209]
- Santillan L, Frederick L, Gilmore S, & Locke J (2019). Brief Report: Examining the Association Between Classroom Social Network Inclusion and Playground Peer Engagement Among Children With Autism Spectrum Disorders. *Focus on Autism and Other Developmental Disabilities*, 34(2), 91–96. 10.1177/1088357619838275
- Scahill L, Bearss K, Sarhangian R, McDougle CJ, Arnold LE, Aman MG, McCracken JT, Tierney E, Gillespie S, Postorino V, & Vitiello B (2017). Using a Patient-Centered Outcome Measure to Test Methylphenidate Versus Placebo in Children with Autism Spectrum Disorder. *Journal of Child and Adolescent Psychopharmacology*, 27(2), 125–131. 10.1089/cap.2016.0107 [PubMed: 27893955]
- Sedgewick F, Hill V, & Pellicano E (2019). ‘It’s different for girls’: Gender differences in the friendships and conflict of autistic and neurotypical adolescents. *Autism*, 23(5), 1119–1132. 10.1177/1362361318794930 [PubMed: 30280923]
- Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, & Baird G (2008). Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child and Adolescent Psychiatry*, 47(8), 921–929. 10.1097/CHI.0b013e318179964f [PubMed: 18645422]
- Sprenger L, Bühler E, Poustka L, Bach C, Heinzl-Gutenbrunner M, Kamp-Becker I, & Bachmann C (2013). Impact of ADHD symptoms on autism spectrum disorder symptom severity. *Research in Developmental Disabilities*, 34(10), 3545–3552. 10.1016/j.ridd.2013.07.028 [PubMed: 23973801]
- Stichter JP, Christ SE, Herzog MJ, O’Donnell RM, & O’Connor KV (2016). Exploring the role of executive functioning measures for social competence research. *Assessment for Effective Intervention*, 41(4), 243–254. 10.1177/1534508416644179
- Stichter JP, Herzog MJ, Owens SA, & Malugen E (2016). Manualization, Feasibility, and Effectiveness of the School-Based Social Competence Intervention for Adolescents (Sci-a). *Psychology in the Schools*, 53(6), 583–600. 10.1002/pits.21928
- Stichter JP, Herzog MJ, Visovsky K, Schmidt C, Randolph J, Schultz T, & Gage N (2010). Social competence intervention for youth with asperger syndrome and high-functioning autism: An initial investigation. *Journal of Autism and Developmental Disorders*, 40(9), 1067–1079. 10.1007/s10803-010-0959-1 [PubMed: 20162344]
- Stichter JP, O’Connor KV, Herzog MJ, Lierheimer K, & McGhee SD (2012). Social competence intervention for elementary students with Aspergers Syndrome and high functioning autism. *Journal of Autism and Developmental Disorders*, 42(3), 354–366. 10.1007/s10803-011-1249-2 [PubMed: 21503797]
- Van Der Oord S, Van Der Meulen EM, Prins PJM, Oosterlaan J, Buitelaar JK, & Emmelkamp PMG (2005). A psychometric evaluation of the social skills rating system in children with attention deficit hyperactivity disorder. *Behaviour Research and Therapy*, 43(6), 733–746. 10.1016/j.brat.2004.06.004 [PubMed: 15890166]
- Varni JW, Seid M, & Kurtin PS (2001). PedsQL™ 4.0: Reliability and Validity of the Pediatric Quality of Life Inventory™ Version 4.0 Generic Core Scales in Healthy and Patient Populations. *Medical Care*, 39(8), 800–812. 10.1097/00005650-200108000-00006 [PubMed: 11468499]
- Wolstencroft J, Robinson L, Srinivasan R, Kerry E, Mandy W, & Skuse D (2018). A Systematic Review of Group Social Skills Interventions, and Meta-analysis of Outcomes, for Children with High Functioning ASD. *Journal of Autism and Developmental Disorders*, 48(7), 2293–2307. 10.1007/s10803-018-3485-1 [PubMed: 29423608]
- Wood-Downie H, Wong B, Kovshoff H, Cortese S, & Hadwin JA (2021). Research Review: A systematic review and meta-analysis of sex/gender differences in social interaction and communication in autistic and nonautistic children and adolescents. In *Journal of Child Psychology and Psychiatry and Allied Disciplines* (Vol. 62, Issue 8, pp. 922–936). *J Child Psychol Psychiatry* 10.1111/jcpp.13337 [PubMed: 33137209]
- Zheng S, Kim H, Salzman E, Ankenman K, & Bent S (2021). Improving Social Knowledge and Skills among Adolescents with Autism: Systematic Review and Meta-Analysis of UCLA PEERS® for Adolescents. *Journal of Autism and Developmental Disorders*, 1–16. 10.1007/s10803-021-04885-1



**Figure 1.**

Scores on social measures as a function of time.

<sup>a</sup> ADOS-SA-CSS= ADOS-2 Social Affect Calibrated Severity Score; AIM= Autism Impact Measure; PedsQL= Pediatric Quality of Life Inventory; SRS= Social Responsiveness Scale, Second Edition

<sup>b</sup> \*\*  $p < .01$

\*\*  $p < .001$

**Table 1**

Sample characteristics by group.

	<b>Total N (%)</b>	<b>ASD n (%)</b>	<b>ASD + ADHD n (%)</b>
	81	37	44
Age (years) <i>M (SD)</i>	10.78 (2.35)	10.11 (2.46)	11.34 (2.21)
Gender			
Male	73 (90.13%)	34 (91.9%)	39 (88.6%)
Female	8 (9.87%)	3 (8.1%)	5 (11.4%)
Race			
White	73 (90.12%)	31 (83.78%)	42 (95.45%)
Black	2 (2.47%)	1 (2.7%)	1 (2.27%)
Asian	2 (2.47%)	2 (5.41%)	0 (0.0%)
Two or More Races	4 (4.94%)	3 (8.11%)	1 (2.27%)
Ethnicity			
Hispanic	2 (2.5%)	1 (2.7%)	1 (2.3%)
Non-Hispanic	79 (97.5%)	36 (97.3%)	44 (97.7%)
Income			
Under 15,000	2 (2.5%)	2 (5.4%)	0 (0.0%)
15–25,000	6 (7.4%)	3 (8.1%)	3 (6.8%)
25–35,000	5 (6.2%)	0 (0.0%)	5 (11.4%)
35–50,000	16 (19.8%)	9 (24.3%)	7 (15.9%)
50–75,000	11 (13.6%)	4 (10.8%)	7 (15.9%)
75–100,000	17 (20.0%)	7 (18.9%)	10 (22.7%)
100,000+	24 (29.6%)	12 (32.4%)	12 (27.3%)

**Table 2**

Comorbid psychiatric diagnoses of participants by diagnostic group.

	<b>Total N (%)</b>	<b>ASD n (%)</b>	<b>ASD + ADHD n (%)</b>
Anxiety Disorder	17 (20.99%)	6 (16.22%)	11 (25.0%)
Bipolar Disorder	2 (2.47%)	0 (0.0%)	2 (4.55%)
Depressive Disorder	7 (8.64%)	1 (2.70%)	6 (13.64%)
Obsessive Compulsive Disorder	7 (8.64%)	2 (5.41%)	5 (11.36%)
Oppositional Defiant Disorder	3 (3.70%)	1 (2.70%)	2 (4.55%)
Tourette Syndrome or Tic Disorder	2 (2.47%)	0 (0.0%)	2 (4.55%)

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**Table 3**

Bivariate correlations among study variables.

	1	2	3	4	5	6	7	8	9
ADOS-SA-CSS	-								
AIM Communication	-.034	-							
AIM Social Reciprocity	.084	.606**	-						
AIM Peer Interaction	.011	.543**	.422**	-					
PedsQL Social Domain	.058	-.243*	-.251*	-.450**	-				
SRS-2 Total T-Score	.004	.548**	.572**	.548**	-.568**	-			
SRS-2 Social Awareness	.030	.327**	.394**	.217	-.192	.695**	-		
SRS-2 Social Cognition	-.112	.463**	.549**	.439**	-.459**	.808**	.409**	-	
SRS-2 Social Communication	-.009	.536**	.540**	.472**	-.549**	.961**	.706**	.732**	-
SRS-2 Social Motivation	.060	.393**	.407**	.639**	-.506**	.729**	.295**	.560**	.633**

<sup>a</sup> ADOS-SA-CSS= ADOS-2 Social Affect Calibrated Severity Score; AIM= Autism Impact Measure; PedsQL= Pediatric Quality of Life Inventory; SRS= Social Responsiveness Scale, Second Edition

<sup>b</sup>\*  $p < .05$

\*\*  $p < .01$

**Table 4**

Comparison of diagnostic groups on baseline clinical characteristics.

	M (SD)/n(%)		Significant Difference
	ASD	ASD + ADHD	
Full Scale IQ	101.41 (14.82)	100.00 (15.81)	$t(79) = 0.41, p = 0.54$
Nonverbal IQ	101.27 (13.16)	99.18 (14.32)	$t(79) = 0.68, p = 0.25$
Verbal IQ	99.95 (13.82)	102.36 (13.18)	$t(79) = -0.80, p = 0.21$
ADOS-SA-CSS	7.57 (1.62)	6.55 (1.88)	$t(79) = 5.80, p < 0.001$
AIM			
Communication	23.89 (8.58)	23.73 (6.56)	$t(79) = 0.09, p = 0.92$
Social Reciprocity	24.97 (6.58)	25.45 (6.54)	$t(79) = -0.33, p = 0.74$
Peer Interaction	20.49 (6.04)	22.16 (5.21)	$t(79) = -1.34, p = 0.18$
PedsQL Social Domain	49.19 (18.62)	47.84 (23.06)	$t(79) = 0.29, p = 0.78$
SRS-2			
Total	71.92 (9.58)	75.35 (9.27)	$t(79) = -1.63, p = 0.11$
Social Awareness	70.97 (10.59)	76.22 (9.96)	$t(79) = -2.29, p = 0.03$
Social Cognition	69.78 (9.80)	70.82 (10.29)	$t(79) = -0.46, p = 0.65$
Social Communication	70.76 (9.79)	74.19 (9.95)	$t(79) = -1.56, p = 0.12$
Social Motivation	66.76 (10.89)	68.82 (11.74)	$t(79) = -0.81, p = 0.42$

<sup>a</sup>The ADOS- SA-CSS is a severity metric with a possible range from 1–10, with higher scores indicating greater impairment. The AIM Communication, Social Reciprocity, and Peer Interaction subdomain raw scores are empirically derived and higher scores indicate greater impairment. The PedsQL Social Domain score range is 0–100, with higher scores indicating better social functioning. The SRS-2 Total and Social Awareness, Cognition, Communication, and Motivation subscale scores are T-scores, with higher scores indicating greater impairment.