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Impact of the START Intervention on Social Competencies

for Young Adults with Autism Spectrum Disorder

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy in Counseling, Clinical, and School Psychology

by

Shereen Jessica Cohen

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Professor Ty Vernon, Chair

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September 2020

The dissertation of Shereen Jessica Cohen is approved.

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   Interventions.*

Koegel, L. K., Cohen, S. J., Koegel, R. L. (2018). Improving Communication
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   Edition.* Paul H. Brooks Publishing, Baltimore, MD.

Van Etten, H. M., Kaur, M., Srinivasan, S. M., Cohen, S. J., Bhat, A., & Dobkins, K. R. (2017). Increased Prevalence of Unusual Sensory Behaviors in Infants at Risk for, and Teens with, Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders, 47(11)*, 3431-3445.

Pallett, P. M., Cohen, S. J., & Dobkins, K. R. (2014). Face and object discrimination in autism, and relationship to IQ and age. *Journal of Autism and Developmental Disorders*, *44*(5), 1039–1054.

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Cohen, S. J., Ko, J., McGarry, E., Vernon, T. (2019, May). Social Conversational Improvements Associated with the Social Tools and Rules for Transitions (START for Young Adults with ASD) Program. Poster presented at International Society for Autism Research: Annual Meeting, Montreal, Canada.

Hai, J., Cohen, S. J., Krasno, A., Vernon, T. W. (2019, May). Parent Education and Communal Experience (PEaCE): Results from Self-Report Questionnaires. Poster presented at International Society for Autism Research: Annual Meeting, Montreal, Canada.

Gengoux, G. W., Cohen, S. J., Ashbaugh, K., Koegel. L. K. (2018, August). Evidence-based Strategies for Improving Socialization for Children and Adults with Autism. Symposium at American Psychological Association Annual Convention, San Francisco, CA.

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# ABSTRACT


Impact of the START Intervention on Social Competencies

for Young Adults with Autism Spectrum Disorder



By

Shereen Jessica Cohen

**Background**: Adults with ASD experience difficulty with social communication and

interaction, which negatively predicts outcomes related to academic and vocational success,

mental health, and quality of life. Social skills groups seem to be a promising model for

addressing social skills deficits for children, adolescents, and adults with ASD. One

promising group-based intervention that targets social competence and motivation is the

Social Tools and Rules for Teens (START) program. Current evidence suggests that

components of the START program (e.g. peer-mediation, an emphasis on experiential

learning, a motivating club-like environment, individualized and group social targets) are

effective in improving the social competence and motivation of transition-aged youth with

ASD. If adapted for the young adult population, the START program holds promise for

targeting social competencies in college-age young adults.

**Method**: A Randomized Control Trial design was used to assess the preliminary efficacy of

the Social Tools and Rules for Transitions (START) program, a modified version of the teen

program adapted for the unique socialization experiences and needs of young adults with

ASD. The participants were 22 adults with ASD (aged 18-25) who were randomly assigned

to the immediate treatment or the waitlist control group. At Pre- and Post-Intervention, all participants completed two standardized self-report measures, as well as video-recorded five-minute conversation probes. Videos were subsequently coded by objective coders for a variety of social behaviors, including eye contact, positive facial expression, question asking, and conversational balance, as well as overall subjective social impression. All video coders and raters were masked to study hypotheses, group assignment, and time point of videos.

**Analyses**: A series of two-way mixed ANOVAs were used to determine whether interactions between treatment conditions (treatment vs. waitlist) and time (pre vs. post) would reveal unique treatment effects of the START program. Additionally, correlational analyses were used to ascertain whether the specific social conversation behaviors would correlate with subjective social impressions, and whether self-report measures were associated with observed social behavior.

**Results**: In regard to self-report measures, analyses revealed a significant Group x Time interaction for the Social Responsiveness Scale, Second Edition (SRS-2) and a trending interaction for the Empathy Quotient (EQ), with the treatment group endorsing improvements on both measures compared with the control group. In regard to conversation behaviors, results revealed a significant interaction for conversational balance. Specifically, the treatment group spoke less and listened more after participating in the START program, which contributed to more evenly balanced conversations on average. Additionally, data trends suggested that the treatment group showed more positive facial expressions during conversation after completing the START program as compared to the control group. No significant effects were found for question asking, eye contact, or subjective social impression ratings. Correlational analyses revealed associations between the two self-report

x

measures, but no significant correlation between self-report measures and any observational measure. The number of questions asked correlated significantly with variables related to conversational balance, as well as with eye contact. Greater use of positive facial expressions was associated with higher subjective social impression ratings.

**Conclusion**: Results suggest that participants of the START group experience more positive views of their own social abilities after participating completing the intervention. Participants of the START program also appear to hold more balanced conversations and show more positive affect after completing this intervention. Question asking was associated with eye contact and conversational balance and reciprocity, while subjective social impression was associated only with positive affect. Overall these preliminary results suggest that the START program for adults with ASD holds promise for improving certain social communication skills and self-perceived social competence.

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## I. Introduction

**Overview**

Individuals diagnosed with Autism Spectrum Disorder (ASD) experience challenges with verbal and nonverbal aspects of social communication, which can include holding a reciprocal conversation, sharing interests with others, expressing emotion, and making appropriate eye contact (American Psychological Association, 2013). These challenges with social communication can interfere with one's ability to make and keep friends and to succeed in academic and vocational settings (Barnhill, 2007; Eaves & Ho, 2008; Robbins, Allen, Casillas, Peterson, & Le, 2006; Zager & Alpern, 2010). Consequently, many young adults with ASD experience poorer outcomes than their typically developing peers in areas of social support, employment, emotional and physical health, and overall quality of life (Barnhill, 2007; Patricia Howlin & Magiati, 2017; Patricia Howlin & Moss, 2012). Effective interventions targeting social skill development are therefore essential for the social, emotional, physical, and economic wellbeing of adults with ASD.

While intervention research for children with ASD has made great strides in recent decades, research on interventions for adults on the autism spectrum is still emerging (Bishop-Fitzpatrick, Minshew, & Eack, 2013; Shattuck et al., 2012; Wong et al., 2015). Extant studies aiming to identify effective social skills interventions for adults with ASD have tended to support the use of behavioral strategies including video-self modeling, in-vivo practice with feedback, visual cues, and self-management (Koegel, Navab, Ashbaugh, & Koegel, 2015; Koegel, Park, & Koegel, 2014; Kornacki, Ringdahl, Sjostrom, & Nuernberger, 2013; Vernon, Miller, Ko, & Wu, 2016; Wong et al., 2015). Incorporating behavioral

strategies is important to address both knowledge and performance deficits. Specifically, one may know what they are supposed to do, but practice and reinforcement are necessary in order to increase and generalize desired behaviors. To achieve mastery of desired social behaviors, adults with ASD need not only explicit teaching of social norms and expectations, but also ample opportunities to practice new skills, receive feedback, and receive reinforcement for improved performance of targeted skills (DeMatteo, Arter, Sworen-Parise, Fasciana, & Paulhamus, 2012). Social skills groups may be an ideal format for delivering these interventions.

Social skills groups appear to hold promise for improving socialization and social communication skills in children (Cappadocia & Weiss, 2011; Derosier, Swick, Davis, McMillen, & Matthews, 2011; Solomon, Goodlin-Jones, & Anders, 2004), teens (Dotson, Leaf, Sheldon, & Sherman, 2010; Laugeson, Frankel, Gantman, Dillon, & Mogil, 2012; Tse, Strulovitch, Tagalakis, Meng, & Fombonne, 2007; Vernon, Miller, Ko, Barrett, & McGarry, 2018; Vernon et al., 2016), and adults (DeMatteo et al., 2012; Gantman, Kapp, Orenski, & Laugeson, 2012; Laugeson, Gantman, Kapp, Orenski, & Ellingsen, 2015) with ASD. Indeed, some have asserted that sufficient evidence has established social skills groups as an evidence-based practice for addressing social challenges related to ASD (Cappadocia & Weiss, 2011; Gates, Kang, & Lerner, 2017; Reichow & Volkmar, 2010). Further studies have identified several essential components of a social skills group for individuals with ASD, including provision of concrete rules for abstract concepts, visual cues and prompts, sequential and progressive teaching of skills, grouping participants by cognitive and linguistic abilities, use of multiple teaching modalities (verbal and visual, didactic and experiential), setting both group and individualized goals, and inclusion of typically

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developing peers (Krasny, Williams, Provencal, & Ozonoff 2003; Miller, Vernon, Wu, & Russo, 2014).

One group-based intervention model that has incorporated the empirically supported components described above is Social Tools and Rules for Teens (START). START is a twenty-week socialization group for adolescents with ASD (age 12-17) that emphasizes peer-mediated intervention, and includes didactic and experiential components. The START program is facilitated by typically developing undergraduate college students and also includes typically developing high school volunteers in order to deliver ecologically valid social skills and provide ample practice with similarly aged peers. The group incorporates role-plays, discussion, didactic lessons, practice activities, and games, all designed to provide information and practice with feedback in a safe and fun environment. The START program has been shown to improve performance of a variety of social skills, as well as improving scores on standardized measures of social ability (Vernon et al., 2016, 2018, Ko, Miller, & Vernon, 2018). In light of the growing need for effective socialization interventions for adults with ASD, the START intervention model may also be beneficial for transition-age young adults (age 18-25), but further research is needed.

Although the majority of investigations of social skills group interventions have used standardized self- and parent-report to measure outcomes (e.g. Derosier et al., 2011; Laugeson et al., 2012; Vernon et al., 2018), some studies have measured outcomes with behavioral observations (Hughes et al., 2011; Ko, et al. 2018; Vernon et al., 2016). Researchers have measured a variety of social behaviors, including initiations, responses, positive comments or topics, eye contact, mutual engagement, and facial expression (Barry et al., 2003; Howlin & Yates, 1999a; Hughes et al., 2011; Ko et al., 2018; McMahon, Vismara,

& Solomon, 2013; Mitchell, Regehr, Reaume, & Feldman, 2010; Vernon et al., 2016). However, in many of those studies, methodological issues such as using the same conversation partners across time points or using coders who were not masked to group or time point may have yielded biased results. For example, if an individual with ASD has the opportunity to interact with someone across multiple time points, they may simply become more comfortable with that person, and their comfort rather than skill is being assessed. If behavioral coders are privy to group or time point, unconscious biases may impact their analyses of behaviors, which would also impact results. Vernon et al. (2016) and Ko et al. (2018) used masked coders in investigating behavioral outcomes in adolescents, however no randomized control trials of social skills groups for adults with ASD have investigated behavioral outcomes using masked coders.

In order to maximize social validity of interventions, it may be helpful to identify and measure social communication behaviors that are likely to predict more global social success. Early research conducted in the 1970's and 1980's indicated that question asking, proportion of time spent talking, eye contact, and smiling were associated with subjective perceptions of conversational ability, social skill, friendliness, and even employability (Minkin et al. 1976; Spence, 1981). Additional research has supported the social importance of eye contact (Baron-Cohen, Wheelwright, & Jolliffe, 1997; Klin, Jones, Schultz, Volkmar, & Cohen, 2003), positive facial affect (Hughes et al., 2011; Koegel, Kim, Koegel, & Schwartzman, 2013; Krstovska-Guerrero & Jones, 2013), question asking (Detar, 2013; Koegel, Koegel, Green-Hopkins, & Barnes, 2010; Vernon et al., 2016) and conversational balance (Hughes et al., 2011; Koegel et al., 2014; Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011).

In sum, adults with ASD are limited in their options for empirically-supported interventions for building socialization and social communication skills. Social skills groups in general show promise, and one particular group-based model, the START program, has been shown to be beneficial for adolescents with ASD, both as measured by self-report and objective behavioral observation (Ko et al., 2018; Vernon et al., 2018, 2016). It is possible that the START program may be effective for transition aged adults as well, as prior research has demonstrated that the components of the START program are likely to be beneficial to adults on the spectrum. In order to gain a complete understanding of how the START program might impact adults on the spectrum, it is important to assess outcomes using a variety of measurement tools. At this time, no RCTs of social group interventions for adults with ASD have been conducted that measure outcomes using both self-report and behavioral observation. It is crucial to continue to develop effective social skill interventions for adults with ASD, and also to develop more comprehensive strategies for measuring outcomes.

**Autism Spectrum Disorder and Social Communication**

Autism Spectrum Disorder is characterized by deficits in social communication as well as restricted and repetitive patterns of behavior or interests. Challenges with social communication may include difficulties carrying on reciprocal conversations, reduced sharing of interests, reduced sharing of emotion or affect, limited eye contact, and difficulties forming or maintaining social relationships. Severity of social communication deficits can range from mild, as defined by an individual who, without support, exhibits difficulties in initiating social interactions, difficulty carrying on back-and-forth conversation, and has difficulty making friends, to severe, as defined by an individual who displays minimal verbal communication, may not respond to social overtures from others, and may only initiate to

meet their basic needs (APA, 2013). Many measures of social communication skills have

been shown to significantly discriminate between individuals with and without ASD,

including the Social Responsiveness Scale (SRS, Bölte, Poustka, & Constantino, 2008;

Frazier et al., 2012) and the Empathy Quotient (EQ, Baron-cohen & Wheelwright, 2004).

Research also indicates that even with intervention, most individuals with ASD will continue

to struggle with delays and deficits in areas of social communication across the lifespan

(Howlin, Goode, Hutton, & Rutter, 2004; Howlin, Moss, Savage, & Rutter, 2013; Pellicano,

2012).

Social communication skills have been shown to significantly predict academic,

vocational, social, and quality of life outcomes (Eaves & Ho, 2008; Zager & Alpern, 2010).

For example, Robbins, Allen, Casillas, Peterson, and Le (2006) investigated predictors of

academic success in typically developing college students, and found that communication

skills, social activity, and social connection were three of the top ten factors predicting

success, alongside study skills, academic discipline, and goal striving. Further, Barnhill

(2007) found that for adults with ASD, challenges in maintaining employment were

generally linked to "poor social communication between employee and employer or

coworkers [and] social skills deficits," (p. 119), adding that social communication deficits

also interfere with performance during job interviews. Howlin et al., (2013) found that the

Reciprocal Social Interaction domain of the Autism Diagnostic Interview, Revised (ADI-R;

Rutter, Le Couteur, & Lord, 2003) was the strongest predictor of mental health, independent

living, employment, and social relations.

As a result of these challenges, adults with Autism Spectrum Disorder (ASD)

experience significant disparities in outcomes related to employment, social support, physical

health, mental health, and overall quality of life (Barnhill, 2007; Patricia Howlin & Magiati, 2017; Patricia Howlin & Moss, 2012). Prior research has suggested that only around half of intellectually able adults with ASD attend any higher education or obtain any paid employment, with only one quarter working full time (Gotham et al., 2015). Only around one third of adults with ASD report having at least one friend and 10% report being in a romantic relationship (Eaves & Ho, 2008). Furthermore, adults with ASD are at increased risk for other psychiatric conditions, most notably depression and anxiety, as well as social isolation (Hofvander et al., 2009). Additionally, Renty and Roeyers (2006) found that perceived social support significantly predicted quality of life in adults with ASD. A meta-analysis of studies comparing quality of life in adults with ASD and typically developing controls revealed a significant negative effect of ASD on quality of life, with a large effect size (Van Heijst & Geurts, 2015). Therefore, it is crucial to continue to support adults with ASD in their social development across the life span.

Unfortunately, resources for adults with ASD are limited. Although laws vary by geographic region, many established supports end after high school, and support that does exist can be difficult for individuals with disabilities to navigate (Wehman et al., 2014). As Adreon and Durocher (2007) explain, IDEA accommodations, which generally include both academic and social goals, no longer apply when students exit public education. Furthermore, the ability to communicate one's needs and advocate for one's self are often necessary to carry accommodations forward into post-secondary education or employment settings. Although ample research exists on treatment paradigms to improve social communication in children with ASD (Mohammadzaheri, Koegel, Rezaei, & Bakhshi, 2015; Odom, Collet-Klingenberg, Rogers, & Hatton, 2010; Prior, Roberts, Rodger, & Williams,

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2011; Spreckley & Boyd, 2009), the majority of adults with ASD continue to struggle in these areas (Seltzer, Shattuck, Abbeduto, & Greenberg, 2004). It is therefore essential to develop effective and disseminable interventions targeting social skills for adults on the autism spectrum.

**Evidence-Based Intervention for Adults with ASD**

Recent reviews of intervention research for adults with ASD generally describe the state of the research as underdeveloped and lacking in quality (Bishop-Fitzpatrick et al., 2013; Shattuck et al., 2012; Wong et al., 2015). Of the studies reviewed, many target job performance, a few target academic or independent living skills, and several target social skills (Shattuck et al., 2012; Taylor et al., 2012). Of the studies addressing social skills, intervention targets typically include social cognition, theory of mind (i.e. perspective-taking), conversation skills (e.g. turn taking, question-asking, comments), social initiations, eye contact, personal space, using and understanding social cues (e.g. nonverbal cues, facial affect), and friendship skills (Bishop-Fitzpatrick et al., 2013; Kornacki et al., 2013; Nuernberger, Ringdahl, Vargo, Crumpecker, & Gunnarsson, 2013; Reichow & Volkmar, 2010). More recent studies have also addressed socialization, question asking, and empathic communication in college aged adults with ASD (Koegel, Ashbaugh, Koegel, Detar, & Regester, 2013; Koegel, Ashbaugh, Navab, & Koegel, 2016; Laugeson et al., 2015; McVey et al., 2016).

According to DeMatteo, Arter, Sworen-Parise, Fasciana, and Paulhamus (2012): "… broad variables underlying social skills deficits consist of: 1) a lack of social knowledge; 2) insufficient practice or feedback; 3) absence of cues or opportunities to perform prosocial behaviors; 4) lack of reinforcement for socially skilled behaviors;

and 5) interfering problem behaviors that hinder acquisition and/or performance of prosocial behaviors," (p. 59).

Strategies shown to address the challenges described above are primarily behavioral in nature, with some cognitive-behavioral interventions as well (Bishop-Fitzpatrick et al., 2013; Reichow & Volkmar, 2010; Shattuck et al., 2012). Specific strategies shown to be helpful for improving social (and other) skills for adults with ASD include video-modeling and feedback (Detar, 2013; Gelbar, Anderson, McCarthy, & Buggey, 2012; Koegel et al., 2016; Koegel, Navab, Ashbaugh, & Koegel, 2015), visually-cued instruction (Koegel et al., 2016; Vedora & Conant, 2015), practice with feedback (e.g. role play; Koegel et al., 2015; Kornacki et al., 2013; Vernon, Miller, Ko, & Wu, 2016), and self-management (Koegel et al., 2015; Koegel, Park, & Koegel, 2014; Palmen & Didden, 2012; Vernon et al., 2016). These interventions have included the traditional individual therapy model, computer-based interventions, and group-based interventions (Taylor et al., 2012).

**Social skills groups.** Social skills groups may be a promising intervention model for improving social skills in children, adolescents, and adults with ASD. In a review, Reichow and Volkmar (2010) assert that social skills groups have accumulated sufficient empirical support to be deemed an Evidence Based Practice (EBP), and numerous more recent studies have yielded further support for that assertion.  A variety of social skills group models have been found to be helpful for children (Cappadocia & Weiss, 2011; Derosier et al., 2011; Solomon et al., 2004), adolescents (Dotson et al., 2010; Laugeson et al., 2012; Tse et al., 2007; Vernon et al., 2018, 2016), and adults (DeMatteo et al., 2012; Gantman et al., 2012; Laugeson et al., 2015) with ASD. Further research has helped to clarify the essential components of an effective social skills group.

Krasny, Williams, Provencal, and Ozonoff (2003) offer some specific

recommendations for effective social skills groups for individuals with ASD. These

recommendations include making abstract concepts more concrete, incorporating visual cues,

providing a predictable routine for each session, grouping participants by language ability,

using multiple modalities for teaching, targeting the most salient and relevant social skills,

explaining the relevance and purpose of target skills, incorporating individualized goals,

teaching sequential skills and integrating along the way, and encouraging generalization

through practice with multiple people across multiple settings. For example, when targeting

the skill of eye contact, it is helpful to make the concept more concrete by specifying that you

should look at someone else's eyes when they are talking to you, and also when you are

talking to them. It is also necessary to explain the reasons for teaching that skill, such as

overtly stating that if you look at people's eyes, then they know you are paying attention

which makes them feel good and increases the chances of a positive interaction. Facilitators

might use visual cues in addition to verbal cues, such as pictures, videos, or role plays, and

provide visual reminders such as pointing at their own eyes to remind the participant to make

eye contact. Other lessons on appropriate listening behavior might start with and build upon

eye contact and continue to integrate the skill of eye contact into future lessons. Participants

would ideally be encouraged to practice that skill both in and out of the group with various

people to promote generalization of the skill to other people and settings.

Correspondingly, Miller, Vernon, Wu, and Russo (2014) conducted a review of social

skills group interventions for adolescents with ASD, highlighting key similarities and

differences between existing programs. They found that most programs do tend to

incorporate the components recommended by Krasny and colleagues (2003), such as

grouping participants by cognitive ability, encouraging practice across multiple settings, and using multiple teaching modalities. Additional key points in this review include recommending that programs be longer than 10 sessions for optimal outcomes, inclusion of individualized target goals tailored to the needs of individual participants in addition to group target goals, and highlighting the importance of both didactic and experiential components. The researchers also emphasized the benefit of incorporating typically developing peers into these group interventions, consistent with current evidence in support of peer-mediated interventions.

      **Peer-mediated intervention.** Numerous studies have demonstrated the benefit of peer-mediated interventions for teaching social skills to individuals with ASD. Chang and Locke (2016) conducted a systematic review of peer-mediated interventions for children with ASD and concluded that peer-mediated interventions are well established as an effective strategy for improving social skills in children with ASD across multiple settings. These results echo many other reviews and meta-analyses establishing the efficacy of peer-mediated intervention for children with ASD (Chan et al., 2009; Wang, Cui, & Parrila, 2011; Watkins et al., 2015; Zhang & Wheeler, 2011). Peer-mediated interventions are hypothesized to be effective because peers are the optimal models of appropriate social behavior, are usually easily accessible, and provide ample opportunities for practice of the targeted skills (Chang & Locke, 2016). Peer-mediated intervention has also been shown to promote maintenance and generalization of newly acquired social skills in children with ASD (Zhang & Wheeler, 2011).

      Fewer studies have extended these promising results to adolescents or adults. Hughes and colleagues (2011) investigated the effect of a peer-mediated intervention for high school

students with ASD and co-occurring intellectual disability, and found that participants improved in their social communication abilities (e.g. conversation skills), had more friends after participating, and exhibited greater positive facial affect during social interactions after peer-mediated intervention. Similarly, an intervention which facilitated practicing of social skills with typically developing peers during lunch clubs in a school setting was found to increase the frequency of social initiations and engagement with peers in high school students with ASD (Koegel et al., 2012; Koegel, Kim, Koegel, & Schwartzman, 2013). Moreover, Schmidt and Stichter (2012) found that including peer-mediated intervention improved generalization and maintenance outcomes for adolescents with ASD.

Little research exists on peer-mediated social skills interventions for adults with ASD, however there is a growing field of research on peer mentorship programs for typically developing college students. For example, Rodger and Tremblay (2003) found that first year university students who participated in a Peer Mentor program achieved higher grades at the end of their first year compared to participants in the control group. They also found an interaction with pre-intervention anxiety, such that students who reported high levels of anxiety at the beginning of the program showed the greatest improvement, performing on par with their non-anxious peers by the end of the mentorship program, whereas anxious students in the control group performed significantly worse than their non-anxious counterparts. Given high co-morbidity rates of anxiety in adults with ASD (Croen et al., 2015; Maddox & White, 2015), this may be further cause to incorporate peer-mediation into interventions for adults with ASD.

**Experiential learning.** Another key component of effective social skills intervention is experiential learning. Experiential learning is a core component of both behavioral theory

(Skinner, 1963) and Andragogy, or adult learning theory (Merriam, 2001). Principles of operant conditioning, which underlie Applied Behavioral Analysis, the most widely accepted evidence-based intervention model for individuals with ASD (Wong et al., 2015), require the learner to engage in a behavior which is then followed by a consequence. The experience of receiving a reinforcement or punishment following a behavior then influences future behavior (Matson et al., 2012). In regard to adult learning theory, experiential learning is the process by which a learner experiences the new behavior sequence, reflects on their experience, generates the abstract concept, and then tests that inductively reasoned theory in subsequent experiences, continuing the cycle of learning (Kolb, Boyatzis, & Mainemelis, 1999).

When experiential learning occurs in a group setting, this is referred to as situated learning. According to Merriam (2001), "real world contexts, where there are social relationships and tools, make the best learning environments," (p. 45-46). The author goes on to explain that when one wants to learn a new skill, it may be helpful to join a club, wherein one "might not only learn solutions to [one's] immediate… problems, but also solutions to possible future problems," (p. 46). It seems that experiential learning in a group-based context may indeed enhance learning tremendously. This concept seems particularly salient for adults with ASD learning social skills. DeMatteo et al. (2012) distinguish between acquisition and performance deficits, explaining that didactic learning addresses acquisition of skills while only experiential learning can adequately target performance deficits For example, an aspiring pianist may read about how to play the piano, watch videos of people playing the piano, and memorize every note and chord, but without practice and feedback, one cannot achieve mastery over the actual performance of that skill. The authors assert that

young adults with ASD may struggle more with performance than acquisition deficits, and therefore require experiential learning opportunities. DeMatteo and colleagues (2012) state:

> "This notion is particularly applicable to young adults with autism spectrum disorder… especially given that most prepackaged programs do not necessarily emphasize developmentally appropriate realistic situations for this population. In all cases, social skills training needs to involve the significant adults and peers in the natural environment." (p. 62)

**START Intervention**

Subsequent to their systematic review of social skills groups (see above, Miller et al., 2014), and based on the evidence described thus far, Vernon and colleagues developed a group socialization intervention for adolescents with ASD, with the aim of incorporating the evidence-based recommendations described above. This intervention, Social Tools and Rules for Teens (START) is described in detail in Vernon, et al. (2016). START is a twenty-week group-based social skills intervention that incorporates didactic and experiential learning in a "club-like" (p. 1810) environment. The START program is peer-mediated in that it is facilitated by trained undergraduate students and high school volunteers. Each week, participants practice skills related to both group goals, as well as individualized target goals. The preliminary study of this intervention combined clinical case series and multiple baseline designs to assess the acceptability, utility, and efficacy of this intervention. Six participants completed the study. Improvements were seen in most or all participants from pre- to post-intervention on self- and parent-report measures of social skill, motivation, and competence. Additionally, to assess progress on individualized target goals, observational measures were

collected using video recorded conversation samples with peers. All participants showed improvements on their target behavior with medium to large effect sizes.

Following this preliminary study, a randomized control trial was conducted to more rigorously assess the efficacy of this intervention in a larger sample of thirty-two participants (Vernon et al., 2018). Results from self- and parent-report measures indicated that participation in the START program contributed to improvements in social outcomes. Additionally, Ko et al. (2018) report on behavioral outcomes of an RCT of START, demonstrating that adolescents who completed the intervention showed greater improvements on social conversation behaviors compared with controls. Although further replication studies are needed, the START intervention shows great promise as a social skills group intervention model, lending further support to the strategies recommended by prior research (Krasny et al., 2003; Miller et al., 2014).

**Measuring Social Outcomes**

Most studies on the efficacy of social skills groups assess outcomes using standardized self- or parent- report questionnaires (e.g. Derosier et al., 2011; Laugeson et al., 2012; Vernon et al., 2018). The majority of studies on social skills groups for adolescents used parent-report measures, typically in addition to self-report measures (Miller et al., 2014), though as noted above, a few have also used behavioral observation data (Hughes et al., 2011; Ko et al., 2018; Vernon et al., 2016). Common self- and parent-report measures used in social skills group research include the Social Responsiveness Scale (SRS; Constantino et al., 2004; Constantino & Gruber, 2005), the Social Skills Rating System (SSRS; Gresham & Elliott, 1990), and the Empathy Quotient (EQ; Baron-Cohen & Wheelwright, 2004) (e.g. Gantman et al., 2012; Laugeson et al., 2015; Vernon et al., 2018).

A few studies have also used standardized performance-based assessment tools, such as the Diagnostic Analysis of Nonverbal Accuracy (DANVA; Nowicki & Carton, 1993) and various performance-based Theory of Mind tasks (e.g. Solomon et al., 2004; Stichter et al., 2010).

Although standardized self- or other-report measures provide valuable information and facilitate meta-analytic reviews, and although much research is conducted to confirm the reliability and validity of questionnaire-based assessment tools, there are limitations. While self- and parent-report measures tend to correlate, adolescents with ASD tend to rate themselves consistently higher than their parents' ratings on social competence, and also tend to report greater improvements after treatment than parents (MacKay, Knott, & Dunlop, 2007; Tse et al., 2007; Vernon et al., 2016). It may come as no surprise that individuals diagnosed with a neurodevelopmental disorder that impacts their understanding of social norms and relationships may not be the most accurate reporters of their own social behavior. Indeed, Mazefsky, Kaoa, and Oswald (2011) recommend caution when interpreting self-report measures of adolescents with ASD. Discrepancies between parent- and self-report measures in adolescent research reveal an even greater challenge in obtaining accurate information for adults with ASD. Specifically, adults with ASD may legally participate in research without the involvement of their parents and may or may not consent to involving their parents. Furthermore, for adult participants who do not live with their parents, parent reports of daily social functioning may be less accurate. Given the current dearth of intervention research for adults with ASD, there is insufficient evidence to determine the validity of self-report measures related to social behaviors and competence.

Several studies have used observational data to assess behavioral outcomes of social skills groups for children and adolescents with ASD. For example, Barry et al. (2003) found that following participation in a social skills group, elementary school children with ASD demonstrated improvements in greetings and play skills as measured by a 43-item rating system. McMahon, Vismara, and Solomon (2013) also collected observational data from children and adolescents during social skills group intervention sessions using a behavioral coding system and found that participants spent more time interacting with and directed more vocalizations toward peers in the group. A number of multiple baseline design studies have assessed behavioral outcomes in adolescents following social skills group participation, and have demonstrated improvements in a variety of social communication skills including initiations, responses, eye contact, and positive feedback (Dotson et al., 2010; Mitchell et al., 2010; Vernon et al., 2016). Ko et al. (2018) measured behavioral outcomes of the START program in an RCT, and found increases in question asking and positive facial expressions, but not mutual engagement, for the treatment group as compared to the control group. These studies support the viability and utility of using behavioral observations to measure outcomes of social skill group interventions.

One study was identified which measured behavioral outcomes of a social skills group for adults with ASD. Howlin and Yates (1999) conducted a descriptive study of a social skills group for adults in which they collected observationally coded behavioral data. Specifically, all participants engaged in two video-recorded social interactions, one in which they were instructed to pretend they are at a party and engage in conversation with another guest, and one in which they were to pretend to be calling a company about an employment opportunity. The investigators measured utterances intended to initiate or maintain

conversations, repetitive utterances, appropriate and inappropriate responses, and requesting and offering information. The authors did not describe how these behaviors were defined, coded, or checked for reliability, although they reported that inter-rater reliability exceeded 75%. Furthermore, no control group was included for comparison. No additional studies of social skills groups for adults could be identified that collected observational data.

**Target Social Behaviors**

In order to measure the efficacy of an intervention through behavioral observations, it must first be determined which behaviors will be observed and measured. As previously stated, core deficits in social communication for individuals with ASD include a variety of verbal and nonverbal communication behaviors. These include deficits in reciprocal (back-and-forth) conversation, reduced sharing of interest, reduced expression of emotion or affect, and limited eye contact (APA, 2013). Autism is a highly heterogeneous disorder (Pelphrey, Shultz, Hudac, & Vander Wyk, 2011), which can make it difficult to identify the most salient social behaviors to target for large groups. However, for those individuals diagnosed with ASD who do not exhibit clinically significant language delay or deficit, in other words, those who possess sufficient spoken language to communicate their needs and desires, certain verbal and nonverbal social communication behaviors emerge as salient targets that are likely to impact the individual's success in social situations. Based on the research described below, behavioral outcomes that are likely to impact overall social success include eye contact, positive facial expression, question asking, and proportion of time spent talking.

Very few studies have investigated which specific social communication behaviors are the best predictors of more global social competence. However, Minkin et al. (1976) conducted a study demonstrating the importance of three specific social behaviors: question

asking, providing positive feedback, and proportion of time spent talking. The investigators video recorded conversations, measured these specific behaviors, and asked naïve raters to rate the overall "conversational ability" (p. 127) of the participants. All participants were typically developing female adolescents and young adults. They found a strong correlation between all three behaviors and subjective ratings. Additionally, they trained the four participants with the lowest subjective ratings to increase their frequency of question asking and providing positive feedback and found that both the behaviors and the subjective ratings increased for all four participants. Similarly, Spence (1981) conducted a study in which adolescent male juvenile offenders completed five-minute video recorded mock interviews with unknown adults, and their behaviors were rated. Those behaviors were then correlated with subjective ratings of "friendliness, social anxiety, social skills performance, and employability," (p. 159). Spence reported that eye contact significantly predicted all four subjective rating variables, smiling predicted ratings of friendliness, amount spoken by the participant predicted ratings of general social skills performance, and question-asking predicted ratings of friendliness, general social skills, and employability. Despite a notable lack of more recent investigations of conversational behaviors that predict social success, research has continued to support these behaviors as goals and outcomes of social skills training for individuals with ASD.

**Eye Contact.** Eye contact is considered a core deficit in ASD (APA, 2013; Hus & Lord, 2014), and is also a common target of social skills interventions (Stichter et al., 2010; Vernon et al., 2018; Wolstencroft et al., 2018), likely because it is a strong predictor of overall social competence (Klin et al., 2002). Because a great deal of social information tends to be communicated through the eyes, including goal, intent, emotion, and attention (Baron-

Cohen, Wheelwright, & Jolliffe, 1997; Kleinke, 1986), failing to make eye contact reduces opportunities for perceiving that information. Additionally, eye contact (in the country and culture in which the present study took place) communicates interest and attention (Kleinke, 1986). Research has also shown that eye contact signals turn taking in a conversation (Ho, Foulsham, & Kingstone, 2015; Johnson, Bavelas, & Coates, 2002), and studies have found that eye contact can be interpreted as an indication of competence (Kleinke, 1986) and even intelligence (Wheeler, Baron, Michell, & Ginsburg, 1979), though more recent replications are needed. In light of research indicating that eye contact remains a challenge for many individuals with ASD (Dalton et al., 2005) and is likely to predict overall perceived social competence, it is likely a valuable intervention goal and outcome measure.

   **Positive Affect.** Delay or absence of social smiling are considered diagnostic criteria for children with ASD (Lord et al., 2012; Rutter, Le Couteur, Lord, & Faggioli, 2005), and adults with ASD may continue to display reduced positive affect during social interactions (Ratto, Turner-Brown, Rupp, Mesibov, & Penn, 2011). While it may seem obvious that smiling is an indication of positive emotional state, studies have shown that smiling is also (perhaps even more strongly) associated with social motivation (Jakobs, Manstead, & Fischer, 1999; Kraut & Johnston, 1979). Smiling has also been utilized in research to measure engagement in a social conversation (Koegel, Kim, Koegel, & Schwartzman, 2013). One study aimed to increase smiling in children with ASD through behavioral intervention, and found that in addition to increasing the frequency of smiles in conjunction with joint attention, this increase in positive facial affect was accompanied by improvements in parent's and teacher's subjective ratings of other aspects of social communication (Krstovska-Guerrero & Jones, 2013). Similarly, in adolescents, increased positive affect was predictive

of social desirability (Hughes et al., 2011). Finally, research has found that social skills interventions may lead to increased positive affect as a collateral gain (Koegel, Kuriakose, Singh, & Koegel, 2012). Furthermore, research has shown that positive affect is strongly and bidirectionally linked with positive social relationships across the lifespan, which in turn bolsters mental health and quality of life (Ramsey & Gentzler, 2015). Therefore, positive affect is an important social behavior that may be impacted by social skills intervention.

**Question Asking.** Question asking is a key social skill that is targeted by many interventions for individuals with ASD (e.g. Detar, 2013; Koegel, Bradshaw, Ashbaugh, & Koegel, 2014; Palmen, Didden, & Arts, 2008; Vernon, Miller, Ko, & Wu, 2016). Studies have shown that children with ASD tend to ask fewer questions than typically developing children (Koegel, Koegel, Shoshan, & McNerney, 1999; Wetherby & Prutting, 1984), and similar results have been found in adults as well, with adults with ASD asking significantly fewer questions in a conversation compared with typically developing controls (Ratto et al., 2011). Furthermore, children with ASD who were taught to ask more questions experienced collateral gains in language and social development (Koegel, Koegel, Green-Hopkins, & Barnes, 2010; Koegel et al., 1999). Numerous intervention studies have targeted questions asking as an important social skill for children (Doggett, Krasno, Koegel, & Koegel, 2013; Koegel et al., 2014), teens (Palmen et al., 2008; Vernon et al., 2016) and adults (Detar, 2013) with ASD.

**Conversational Balance.** Conversational balance refers here to the back-and-forth nature of a conversation and the extent to which each conversation partner contributes relatively equally to the conversation. As noted previously, reciprocal conversation tends to be a challenge for individuals with ASD. In some cases, individuals with ASD may speak

excessively about their perseverative interest without giving their conversational partner a sufficient opportunity to contribute to the conversation, while some individuals with ASD may offer short answers without sufficient elaboration, commentary, or turn signaling (Paul, Orlovski, Marcinko, & Volkmar, 2009; Turner-Brown et al., 2011). Therefore, interventions have been developed that aim to teach individuals with ASD to engage in a more reciprocal and balanced conversation. In one study, researchers created a visual framework for how to have a conversation, then asked children with ASD to self-manage their own performance in following the steps laid out for them (Koegel, Park, & Koegel, 2014). Specifically, participants were instructed to (1) respond to the question posed by the conversation partner, (2) add relevant information, and (3) ask a question. Notably, naïve raters rated the participants higher on apparent interest in the conversation, reciprocity, and overall desirability as a future conversational partner after the intervention. Similarly, Nuernberger et al. (2013) used visual cues and practice with feedback to teach adults with ASD to hold a balanced and reciprocal conversation, and found that all participants improved in their performance. Improved reciprocity is likely to impact the conversation partner's enjoyment of the interaction, which in turn is likely to impact chances for developing social relationships (Hughes et al., 2011).

**Present Study**

The present study investigates the efficacy of the Social Tools and Rules for Transitions (START) intervention program for young adults with ASD. The START program for transition-age adults (age 18-25) was adapted from the program originally developed for adolescents (Vernon et al., 2018; Vernon et al., 2016). START uses typically developing college-aged facilitators and combines didactic and experiential learning in a club-like

atmosphere to target social skills in young adults (ages 18-25) with ASD. In order to assess the efficacy of this intervention, the present study will analyze self-report measures, behavioral observation data, and subjective social impression ratings to build a holistic picture of how this program impacts participants' social skill development. Thus, the present study seeks to test the hypotheses that young adults with ASD who participate in the START program (1) will rate themselves as more socially skilled on the Social Responsiveness Scale, Second Edition (SRS-2, Constantino & Gruber, 2012) and the Empathy Quotient (EQ, Baron-cohen & Wheelwright, 2004), (2) will show greater increases than controls in operationally defined, observable social communication behaviors, specifically, eye contact, positive facial expression, question asking, and conversational balance, and (3) will show greater improvements than the control group on subjective social impression ratings after completing the START program.

## II. Method

This project was approved by the Institutional Review Board (IRB) at the University of California, Santa Barbara.

### Participants

Participants were adults age 18-25 with a diagnosis of ASD, per the criteria in the DSM-5 (APA, 2013). For inclusion in this study, participants needed to be able to communicate using full sentences and needed to have a Verbal IQ of at least 70, as measured by the Kaufman Brief Intelligence Test, Second Edition (KBIT-2; Kaufman & Kaufman, 2014). All participants were required to present written documentation of a prior ASD diagnosis.

Participants were recruited primarily through the targeted advertisements on social media. Recruitment for this study also included referrals from the Disabled Student's Program at the University where the present study took place, as well as through the California State Department of Rehabilitation. Participants were compensated for their time and participation with a $20 gift card at intake. Participant demographic data may be found in Table 1.

Three cohorts of study participants were recruited and randomized. For a participant's data to be included in the Treatment group, a minimum of 80% attendance was required. A total of 10 participants in the treatment group and 12 participants in the waitlist group were included in the present study. A CONSORT diagram showing recruitment, enrollment, and completion numbers can be found in Figure 1.

**Design**

  The present study used an RCT design with a waitlist control. Data from two time-points were used: Pre-Treatment, which occurred the week before the beginning of the 20-week intervention, and Post-Treatment, which occurred within one week of the final session of the intervention. Between Pre- and Post-Treatment, the Treatment group received the START intervention, while the waitlist group did not. The waitlist group later had the opportunity to complete the intervention.

**Procedure**

  **Social Facilitator Training.** Social facilitators were undergraduate students attending the university in which the present study took place. These facilitators were research assistants receiving course credit for their time. Facilitators were required to complete a four-hour training in which they learned techniques for group facilitation, basic counseling skills, and strategies for building rapport with clients. They were also taught how to implement the intervention being tested in this study and engaged in practice sessions. During the intervention, each facilitator was assigned to be the Peer Mentor to one of the group participants, and was responsible for conducting check-in and check-out meetings (see below) as well as tracking that client's progress throughout the intervention. Facilitators also attended weekly one-hour supervision meetings with a graduate student and a licensed psychologist.

  **Intake.** All potential participants completed an intake lasting approximately 2 hours to determine eligibility for participation. First, consent forms were reviewed and signed. Participants then completed the KBIT to ensure that they met the IQ cut-off for participation. Additionally, participants completed self-report survey measures and video recorded

conversation probes, all described in detail in the *Dependent Measures* section below. Participants were also administered a "Target Skills Survey," Described below.

**Individualized target goals.** Participants completed a "Target Skills Survey," comprised of a checklist of twelve common social difficulties and space to write in additional challenges. Social skills listed on the survey included eye contact, asking questions, on-topic comments, appropriate vocal volume/rate/intonation, choosing appropriate conversation topics, etc. Participants were asked to rank the three highest priority challenges. Their responses to these items, as well as the clinical judgment of the clinician conducting the intake, were used to identify the individualized target goal, which would be targeted in addition to the weekly group goals. All participants were provided small, hand-held, digital tally counters for each group session, and asked to self-manage their target behavior during each group meeting. Self-management is a behavioral technique in which an individual monitors their own behavior and gives themselves a "point" each time they correctly engage in a behavior. Research has shown that self-management is an effective intervention strategy for increasing a wide variety of target behaviors (Carr, Moore, & Anderson, 2014; Flynn & Healy, 2012; L. K. Koegel et al., 2014; Lee, Simpson, & Shogren, 2007). For example, if a participant's individualized target goal was question asking, they would click the tally counter each time they asked a fellow group member a question. Afterward, their total score was recorded by their peer mentor (see *Check-Out* below).

**START Program Sessions.** START is a 20-week program that meets for 1.5 hours once per week. Sessions are led by typically developing undergraduate university students who are trained according to procedures described above (see *Social Facilitator Training*). Each session includes both structured and unstructured time, as well as didactic and

experiential components. The group is designed to create a club-like atmosphere to create an immersive yet supportive social experience. The program covers a range of topics that focus on areas of social development needed to be successful in a range of settings relevant to young adults. The program is designed to target skill and performance deficits, as well as social motivation and insight. Each component of START program sessions are described in greater detail below.

*Check-In.* Participants completed a five-minute check-in before each group session. The check in was conducted by the participant's assigned peer mentor. During these check-in sessions, participants reviewed their goals and social experiences from the previous week. If the participant experienced any social challenges over the prior week, they discussed the issue and how one might address similar situations in the future. The participant and their peer mentor reviewed their progress on their individualized goal and briefly practiced self-managing that goal. Lastly, the facilitator primed the participant by introducing the topic of the week and asking them to think of a relevant experience they might be able to share in group related to the topic. For example, if the topic of the week was living with others, they might be prompted to think of a positive or challenging experience they had while living with a roommate, sibling, or parent. Additional priming was used to remind the participant to attend to their self-management goals during the group portion of the session (described above, see *Individualized Target Goals*).

*Unstructured Socialization Phase.* During the first 20 minutes of the group session, all group members engaged in unstructured social time. This period was intended to allow participants to focus on practicing their individual goals, while creating a safe and fun environment. Participants were allowed to talk about whatever topic they chose, and could

interact with each other, facilitators, or both. Topics of conversation typically included movies, TV shows, current events, school, food, etc. Snacks were provided, and facilitators were engaging but nondirective with participants.

  ***Discussion and Practice Phase.*** After the unstructured social time, participants were asked to reflect on the previous week's topic (for weeks 2-20), share what they remembered, and share any stories or experiences related to the topic of the previous week. Feedback was provided as appropriate, for example providing praise, encouragement, or suggestions. Facilitators then introduced the topic for the current week. Weekly topics are listed in Table 2. Facilitators then presented either a video or a role play related to the topic. Videos were followed by discussion of what the characters in the clip did well or poorly and why. Similarly, role plays included one bad example, and one good example, followed by a discussion of what went well or poorly and why. Facilitators then engaged participants in discussion about the topic, eliciting ideas from the participants through Socratic questioning and writing down important points. Facilitators additionally shared relevant stories from their own life experiences to illustrate points about the topic, and elicited stories from participants as well. If they were able to think of a story during check-in, but their peer mentor noticed hesitation during the group discussion, that facilitator might encourage the participant to share the same story they had told earlier. Participants then had the opportunity to immediately practice the skill either in dyads, small groups or all together, depending on the topic. For example, during the week on humor, group members were asked to pair off and practice telling one another jokes or humorous anecdotes, as well as practicing appropriate responses to their partner's jokes. This in vivo practice allowed participants to practice the skill in a safe environment, receive immediate feedback, and also put that feedback into

immediate practice, with the aim of enhancing mastery and confidence of the various skills. After the Group Activity Phase (see below), all group members were asked to practice a specific skill related to the topic of the week.

       ***Group Activity Phase.*** After group discussion and practice, a group activity was introduced. Activities varied each week, and usually included common team-building or party games. Activities included *Social Bingo, 20 Questions, Apples to Apples, Zingo, Never Have I Ever, Human Knot*, and so on. This group activity phase was designed to be enjoyable and reinforcing in order to increase motivation and engagement of participants. Whenever feasible, the game would also be related to the topic of the week, offering additional opportunities to practice skills such as asking questions, showing interest, sportsmanship, team work, etc.

       ***Check-Out.*** After the group session, each participant met with their peer mentor for a five-minute check-out. During check-outs, the peer mentor would reflect to the participant what they saw them doing well, suggestions for what they could continue working on, and progress they have seen overall. Additionally, the peer mentor would review both individual goals and weekly goals. The peer mentor recorded the tally count from the participant's individualized goal for that day and prompted them to set specific and measurable goals related to their individual and group goals for the upcoming week. Participants took home goal worksheets to complete as homework and bring back the following week. Out of session practice was considered essential for maintenance and generalization of skills.

**Dependent Measures**

       **Standardized Self-Report Measures.** All participants completed the following self-report measures before and after the 20-week START program.

***Social Responsiveness Scale, Second Edition (SRS-2).*** The SRS-2 (Constantino &

Gruber, 2012) is a 65-item scale that asks the reporter to rate statements on a scale of 1 (Not

True) to 4 (Almost Always True). Participants completed the Adult Self-Report form. Items

on the SRS-2 relate to Social Awareness, Social Cognition, Social Communication, Social

Motivation, Restricted Interests, and Repetitive Behavior. Frazier and colleagues (2014

confirmed the factor structure of the SRS-2. Bruni (2014) reports good reliability for the

SRS-2, including internal consistency (.94-.96), test retest reliability (.88-.95), and interrater

reliability (.61-.92). Additionally, Mandell et al., (2012) found good predictive validity, with

a specificity level of .60 and a sensitivity level of .86.

***Empathy Quotient (EQ).*** Participants completed the EQ (Baron-Cohen &

Wheelwright, 2004) at both time points to assess their levels of empathy, a construct which

includes the ability to understand the thoughts, emotional responses, motives, and

perspectives of others. The EQ is a 60-item self-report measure that provides statement such

as "I can easily tell if someone else wants to enter a conversation," and "I can't always see

why someone should have felt offended by a remark." The respondent marks strongly agree,

slightly agree, slightly disagree, or strongly disagree for each item. The EQ has been found to

have good test-retest reliability ($r = 0.83$) and moderate concurrent validity with other

measures, such as subscales of the Interpersonal Reactivity Index (IRI; $r = 0.58$, $r = 0.44$;

Lawrence et al., 2004). Baron-Cohen and Wheelwright (2004) found that EQ scores differ

significantly between individuals with and without ASD, and propose a cut-off score of 30,

with scores below 30 indicating greater deficit in empathy.

**Conversation Behaviors.** At Pre- and Post-Treatment, all participants engaged in a

five-minute conversation probe with one male and one female unfamiliar peer. These peers

were recruited through announcements in undergraduate courses and were unaffiliated with the present research study and naïve to project aims and hypotheses. Conversations were video recorded, with the camera and participants angled such that facial expressions and eye gaze could be observed for later coding.

Four videos for each participant were included in the present analyses, two at Pre-Treatment and two at Post-Treatment. The data for the two videos at each time-point were averaged for each social behavior. Videos were coded by undergraduate research assistants. Coders were masked to the time-point of the video, the group to which the participant was randomized, and to the hypotheses of the present study. Coders used Noldus Observer software (Noldus, 1991; Zimmerman, Bolhuis, Willemsen, Meyer, & Noldus, 2009) to code the videos. Fifty percent of videos were coded by a second coder for reliability (see *Inter-Rater Reliability* below). Four social communicative behaviors were observed and coded: two nonverbal and two verbal. The nonverbal behaviors coded in the present study were eye contact and positive facial expression. The verbal behaviors coded in the present study were question asking and conversational balance.

### *Nonverbal social conversation behaviors.*

*Eye Contact*. Eye contact is a common deficit in ASD and is considered an important social skill for communicating interest and attention (Hus & Lord, 2014; Kleinke, 1986). Eye contact was defined as any time the participant's gaze was directed toward the face of the conversation partner. Coders were instructed to press a button each time the participant began looking at the conversation partner's face, and a different button when they looked away. Each time the participant looked at the person's face and away, regardless of the length of

duration, the coder was instructed to code each instance of looking at and looking away. The percentage of the time spent looking at the conversation partner's face was analyzed.

*Positive facial expression.* A limited range of facial expression is a common feature of ASD, and positive facial expression is considered an important social skill for communicating enjoyment, friendliness, and social engagement (Hughes et al., 2011; Jakobs et al., 1999; Ratto et al., 2011). Facial expressions were rated in three-second intervals. Every three seconds, the video paused and coders were asked to indicate the presence or absence of a positive facial expression on the face of the participant at any point during the previous three seconds. Positive facial expression was defined as smiling with or without laughter, and coders were instructed to look for cheeks rising, corners of lips turned up, eyes squinting, dimples showing, etc. Proportion of intervals in which a positive facial expression occurred were analyzed.

### Verbal Conversation Behaviors.

*Question asking.* Individuals with ASD tend to ask fewer questions in a social conversation than do typically developing peers, and this behavior is important for showing interest and building social relationships (Detar, 2013; Minkin et al., 1976; Ratto et al., 2011). Coders recorded each time either person in the conversation (participant and partner) asked a question. A question was defined as any request for information that if written, would end with a question mark, and was intended to elicit a response from the conversation partner. If a question was rhetorical and not intended to elicit a response (e.g. "really?" or "you know?"), it was not counted as a question. Additionally, if a participant or conversation partner asked a string of questions in a row, coders were instructed to press the button only after the *last* question. The number of questions asked by the participant was analyzed.

*Conversational balance.* Prior research has shown that individuals with ASD tend to have less balanced conversations that their typically developing counterparts, and conversational balance has been shown to communicate interest and predict desirability as a future social partner (L. K. Koegel et al., 2014; Paul et al., 2009; Turner-Brown et al., 2011). Proportion of time engaging in speaking versus listening behavior was coded in three-second intervals. Every three seconds, the video paused and coders were prompted to indicate whether, in the last three seconds, the participant was (a) the speaker only, (b) the listener only (i.e. only the conversation partner was speaking), (c) both speaker and listener (i.e. both people spoke during that interval), or (d) neither speaker nor listener (i.e. neither person spoke during that interval). Importantly, minimal encouragers, or vocalizations which do not contribute to the content of the conversation, but rather show that a person is listening (e.g. "uh-huh") were not coded as speaking behavior. The percent of intervals for each category were analyzed separately.

**Inter-Rater Reliability.** Inter-rater reliability for conversation behaviors was calculated for 50% of all videos. Percent agreement and Cohen's Kappa are presented in Table 3. Mean percent agreement across all four behaviors was 86.25% (SD = 3.77%), and the mean Cohen's Kappa was 65.75% (SD = 9.54%), indicating moderate to substantial agreement (Cohen, 1960; McHugh, 2012).

**Subjective social impression ratings**. Three research assistants who were naïve to the hypotheses of the study, as well as being masked to group or time-point of each video, provided subjective social impression ratings for each video. Specifically, each subjective rater was shown all videos in random order, and after each video, was instructed to respond to four questions/statements: (1) How strong are this person's social skills? (2) How

comfortable does this person seem? (3) How socially awkward does this person seem? (4)

This person is likely to have a lot of friends. For each item, raters were asked to provide a

number from 1-10 with 10 being the highest (i.e. strongest, most comfortable) and 1 being

the lowest. Item number three was reverse-scored, and all ratings were summed to yield total

subjective social impression score for each video. Scores from videos with male and female

conversation partners were averaged for each time point, and scores from all three raters

were also averaged for each time point, such that each participant was given an average

subjective social impression rating score for pre- and post-intervention.

**Analyses**

In order to determine whether the data would reveal a Group (Treatment vs. Waitlist)

x Time (Pre vs. Post) interaction on any outcome measure, data were analyzed using two-

way mixed ANOVAs for each dependent variable. For self-report measures, separate

ANOVAs were run for the SRS-2 and the EQ. Additionally, for conversation behaviors,

separate ANOVAs were run for the percent of time the participant was making eye contact,

the proportion of intervals in which the participant displayed a positive facial expression, the

number of questions asked by the participant in the five-minute conversation, and the

proportion of intervals in which the participant was the speaker only, the listener only, both,

or neither. Further, in order to clarify any differences that emerge in speaker-only and

listener-only intervals, a difference score was calculated, and an additional ANOVA was

used to analyze the difference scores between speaking and listening intervals. The

difference score was calculated as follows:

Difference = Absolute Value (Percent of Speaker-Only Intervals - Percent of Listener-Only Intervals)

Based on the above calculation, the smaller the difference between the percentage of speaker-

only and listener-only intervals (i.e. more equally balanced), the closer the difference score

will be to zero. Subjective social impression ratings were also analyzed using a two-way mixed ANOVA. Pre- and post-intervention ratings were averaged across the three naïve raters and across the gender of the conversation partner, yielding an overall subjective rating score at each time point for each participant. If analyses reveal a significant Group x Time interaction in any of these measures, it would indicate that the treatment and waitlist groups' scores changed differently over the course of the intervention.

Additionally, Bivariate Correlational analyses were used to determine if any of the conversational behaviors are associated with the subjective ratings, and if the standardized self-report measures are associated with any of the observational measures of social communication.

## III. Results

**Demographics**

One-Way ANOVAs were used to compare the treatment and waitlist groups on age, Verbal IQ, Nonverbal IQ, and IQ Composite. There were no significant differences between groups on age $(F(1,20)=0.062, p = 0.805)$, Verbal IQ $(F(1,20)=0.115, p = 0.738)$, Nonverbal IQ $(F(1,20)=0.004, p = 0.950)$, or IQ Composite $(F(1,20)=0.040, p = 0.843)$.

Chi Squared tests were used to compare the treatment and waitlist group on gender and race/ethnicity. These analyses revealed no group differences on gender $(\chi^2 = 1.691, p = 0.193)$ or on race/ethnicity $(\chi^2 = 0.006, p = 0.937)$.

**Primary Analyses: RCT Outcome Measures**

**Standardized Self-Report Measures.** Results of the SRS-2 and EQ were analyzed using two-way mixed ANOVAs. These analyses revealed a significant group x time interaction on the SRS-2 Total T-scores, $F(1,20) = 5.744, p=0.026$, partial $\eta^2 = 0.223$, with the treatment group showing a decrease (i.e. improvement) on average from 60.8 (SD = 11.7) to 56.5 (SD = 8.5) and the waitlist group showing an increase from a mean of 64.6 (SD = 9.7) to 67.6 (SD = 11.0). Analyses also revealed a trending but non-significant group x time interaction on the EQ, $F(1,20) = 3.296, p = 0.084$, partial $\eta^2 = 0.141$, with the treatment group showing an increase (i.e. improvement) from a mean of 32.8 (SD = 11.8) to 39.9 (SD = 10.5) and the waitlist group showing a smaller increase from a mean of 28.4 (SD = 10.3) to 29.9 (SD = 10.2). Effect sizes were large for both interactions, according to guidelines provided by Cohen (1988). Results of the SRS-2 and the EQ are presented in Figures 2 and 3, respectively.

**Nonverbal Conversation Behaviors**. Two-way mixed ANOVAs were run separately for eye contact and positive facial expression. Notably, for one participant in the treatment group, they were out of frame for the entirety of the post-intervention videos. That participant was therefore excluded from analyses of nonverbal behaviors.

*Eye Contact*. Analyses revealed no significant group x time interaction for eye contact, $F(1,19) = 0.326$, p=0.575, partial $\eta^2 = 0.017$. The effect size was small (Cohen, 1988). The treatment group increased slightly on average in the percentage of time making eye contact from 55% (SD = 23%) at to 60% (SD = 18%) and the waitlist control group remained relatively stable in the percentage of time they were making eye contact from a mean of 60% (SD = 23%) at to 61% (SD = 20%). Data for this behavior are presented in Figure 4.

*Positive Facial Expression*. A two-way mixed ANOVA revealed a trending but non-significant group x time interaction for positive facial expression, $F(1,19) = 3.406$, p=0.081, partial $\eta^2 = 0.152$. The effect size was large (Cohen, 1988). The treatment group increased in the percentage of intervals during which a positive facial expression was observed from a mean of 23% (SD = 17%) at to 32% (SD = 18%) and the waitlist control group remained relatively stable on average in the percentage of intervals during which a positive facial expression was observed from 26% (SD = 17%) at to 27% (SD = 18%). Data for this behavior are presented in Figure 5.

**Verbal Conversation Behaviors**. Analyses for question-asking and conversational balance are presented below.

*Question Asking*. A Two-way mixed ANOVA revealed no significant group x time interaction for question asking, $F(1,20) = 0.910$, p=0.351, partial $\eta^2 = 0.044$. The effect size

was small (Cohen, 1988). The treatment group increased slightly in the number of questions asked during a five-minute conversation from a mean of 4.55 (SD = 4.39) at to 5.22 (SD = 3.11) and the waitlist control group decreased slightly in the number of questions asked during a five-minute conversation from a mean of 4.50 (SD = 4.27) at to 4.21 (SD = 4.01). Data for this behavior are presented in Figure 6. Additionally, the mean number of questions asked by the treatment group, the control group, at the typically developing peers at each time point is presented in Table 4.

*Conversational Balance.* Two-way mixed ANOVAs were conducted specifically for the proportion of intervals in which the participant was the speaker only, the listener only, both speaker and listener, and neither speaker nor listener.

*Speaking only.* A Two-way mixed ANOVA revealed a significant group x time interaction for intervals in which the participant was the speaker only, $F(1,20) = 15.073$, $p=0.001$, partial $\eta^2 = 0.430$. The effect size was large (Cohen, 1988). Intervals in which the participant was engaged only in speaking behavior decreased for the treatment group from a mean of 34% (SD = 11%) to 27% (SD = 9%) and increased for the waitlist group from a mean of 26% (SD = 12%) to 33% (SD = 17%) from pre- to post-treatment. Data for this behavior are presented in Figure 7.

*Listening only.* A Two-way mixed ANOVA revealed a significant group x time interaction for the percentage of intervals in which the participant was the listener only, $F(1,20) = 6.600$, $p=0.018$, partial $\eta^2 = 0.248$. The effect size was large (Cohen, 1988). The proportion of intervals in which the participant was the listener only (and only the conversation partner was speaking) increased for the treatment group from a mean of 25% (SD = 8%) to 29% (SD = 10%) and decreased for the waitlist group from a mean of 33% (SD

= 13%) to 28% (SD = 13%) from pre- to post-treatment. Data for this behavior are presented in Figure 8.

*Both speaking and listening*. A Two-way mixed ANOVA revealed no significant group x time interaction, $F(1,20) = 2.845$, p=0.107, partial $\eta^2 = 0.125$. The effect size was medium (Cohen, 1988). Intervals in which the participant was engaged in both speaking and listening behavior showed a small increase for the treatment group from a mean of 39% (SD = 9%) to 42% (SD = 7%) and showed a small decrease for the waitlist group from a mean of 38% (SD = 6%) to 35% (SD = 10%) over the course of the 20 week program. Data for this behavior are presented in Figure 9.

*Neither speaking nor listening*. One participant in the waitlist control group was found to be an outlier for this variable, as defined by greater than three standard deviations from the mean, and was therefore excluded from this analysis. A Two-way mixed ANOVA revealed no significant group x time interaction, $F(1,19) = 0.255$, p=0.619, partial $\eta^2 = 0.013$. The effect size was small (Cohen, 1988). Intervals in which the participant was engaged in neither speaking nor listening behavior remained relatively stable for both groups, at 2.1% (SD = 1.0%) and 1.8% (SD = 0.9%) for the treatment group at pre and post, respectively, and at 2.3% (SD = 1.0%) and 2.0% (SD = 1.0%) for the waitlist group at pre and post, respectively. Data for this behavior are presented in Figure 10.

*Speaker-Listener Difference Score*. One participant in the treatment group was found to be an outlier for this measure, as defined by greater than three standard deviations from the mean and was therefore excluded from this analysis. The treatment group's difference score between speaker-only and listener-only intervals decreased from a mean of 14.85% (SD = 11.02%) to 10.87% (SD = 5.79%) while the waitlist group increased from a mean of 18.60%

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(SD = 16.38%) to 23.63% (SD = 14.86%). The ANOVA revealed no significant Group x

Time interaction for this measure, $F(1,19) = 1.497$, p=0.236, ηp2 = 0.073. The effect size was

medium (Cohen, 1988). These results are presented in Figure 11.

**Subjective Social Impression Ratings.** The mean score from three subjective raters

was analyzed using a Two-way mixed ANOVA. Analysis revealed no significant Group x

Time interaction for subjective ratings, $F(1,20) = 0.004$, p=0.950, partial $\eta^2 = 0.0002$. The

treatment group's mean subjective rating scores were 26.95 (SD = 5.33) at pre and 28.02 (SD

= 4.41) at post, and the control group's mean scores were 22.29 (SD = 5.61) at pre and 23.43

(SD = 6.89) at post. Results of the subjective impression ratings are presented in Figure 12.

The results of all RCT outcome measures, including self-report, conversation

behaviors, and subjective social impression ratings, are presented in Table 5.

**Correlational Analyses**

To ensure that no outlier would impact the correlations, one participant from the

waitlist group who had been found to be an outlier on one of the variables in question was

excluded from the analyses. Both groups were analyzed together. This resulted in a sample

size of 21 participants for correlational analyses. Results of the correlational analysis may be

found in Table 6.

Significant correlations were found between the SRS and EQ ($r(21) = -0.683$, p =

0.001), eye contact and question asking ($r(20) = 0.469$, p = 0.037), eye contact and

proportion of speaker-only intervals ($r(20) = -0.484$, p = 0.031), question asking and

proportion of speaker-only intervals ($r(21) = -0.525$, p = 0.015), question asking and

proportion of both-speaker-and-listener intervals ($r(21) = 0.529$, p = 0.014), speaker-only and

listener-only intervals ($r(21) = -0.729$, p < 0.001), speaker-only and both-speaker-and-listener

intervals ($r(21) = -0.569$, $p = 0.007$), and between subjective social impression ratings and

positive facial expressions ($r(20) = 0.519$, $p = 0.006$). No other correlations reached

significance.

## IV. Discussion

The present study sought to determine whether young adults with ASD who participate in the START program exhibit improvement in verbal and nonverbal social communication behaviors, receive higher subjective ratings of overall social competence and desirability, and rate themselves more favorably on measures related to social communication following the intervention. An RCT with a waitlist control was conducted to assess the impact of the program. We hypothesized that the treatment group would rate themselves more favorably on survey measures as well as demonstrate greater improvements in observed areas of social communication after completing the intervention. It was further hypothesized that the treatment group would show greater improvements on overall subjective social impression, compared to the waitlist control group. Finally, this study sought to investigate the associations among these various outcome measures.

### RCT Outcomes

**Self-report measures.** Results suggested that the treatment group improved more than the waitlist group on two standardized self-report measures of social communication. Specifically, a significant interaction was found for the SRS-2 and a trending interaction was found for the EQ, both with large effect sizes. On the SRS-2, the treatment group moved from the mild range to the sub-clinical range, while the control group moved from the mild range into the moderate range on average. On the EQ, both groups began within one standard deviation of the cut-off score associated with likely ASD symptomatology (Baron-Cohen & Wheelwright, 2004). At the second time point, the waitlist group remained just below the cut-off score (with lower scores indicating lower empathic skill) while the treatment

appeared to approach the average range for typically developing adults, per norms reported by Baron-Cohen and Wheelwright (2004). The SRS-2 and EQ are used in many studies of intervention outcome (Gantman et al., 2012; Spain & Blainey, 2015; Wolstencroft et al., 2018), and the results of this study are consistent with prior reports showing improvements on these measures as a result of participation in a social skills group for ASD (Gantman et al., 2012; Laugeson et al., 2015; Vernon et al., 2018).

**Conversation behaviors.** In regard to social conversation behaviors, analyses revealed significant interactions in conversational balance variables, with the treatment group appearing to hold more balanced and reciprocal conversations after completing the intervention. Additionally, analyses revealed and a trend toward greater increases in positive facial expressions for the treatment group, as compared with the control group. However, analyses failed to show significant effects for question asking or eye contact. Although results were not statistically significant for all conversation behaviors, all observed changes did appear in the expected directions. Specifically, in regard to question asking, eye contact, and positive facial expressions, the treatment group exhibited increases in these behaviors, consistent with the direction of hypothesized effects, while the control group exhibited smaller increases, no change, or even slight decreases. Notably, there was substantial variability across participants within each group for all of these behaviors, which may explain the absence of significant results.

*Conversational balance.* Analyses suggest that the treatment group showed improvements in conversational balance and reciprocity compared to the control group after participating in the START program. Specifically, a moderate effect was observed for the proportion of intervals in which both conversation partners spoke, indicating a trend toward

increased conversational turn taking for the treatment group. Additionally, the treatment group showed a decrease in the proportion of intervals in which they were the speaker only, and an increase in the proportion of intervals in which they were the listener only (and their conversation partner was the speaker). Further analysis showed that these changes reflected less discrepancy between speaker-only and listener-only intervals, suggesting greater balance in conversational contributions following completion of the START intervention. This finding is consistent with some of the results of Vernon et al., (2016), wherein participants who tended to monopolize conversations were able to reduce their verbal contributions during conversation probes. This result is additionally consistent with Hughes et al (2011) which found that a peer mediated social skills intervention can be an effective strategy for increasing conversational reciprocity. However, the results of the present study were inconsistent with finding by Ko, Miller, and Vernon (2018), which did not find increased conversational reciprocity for adolescents who completed the START program. Further investigation of this variable in both age groups is needed.

This outcome is encouraging given prior research demonstrating conversational abnormalities in individuals with ASD. For example, Paul et al. (2009) demonstrated that adults with Asperger Syndrome and PDD-NOS (i.e. individuals who would now be diagnosed with ASD with low support needs) tend to offer excessive and irrelevant detail, display lower conversational reciprocity, and perseverate more on preferred topics compared with typically developing adults. Moreover, the frequency and persistence of engaging in perseverative speech on topics of circumscribed interest has been shown to interfere with social interactions and relationships (Turner-Brown et al., 2011). It is therefore likely that these observed changes in the distribution of speaking, listening, and turn-taking behaviors

reflect a change that will help the participants of the START program have more successful social interactions, and increase their chances of developing positive peer relationships.

*Question asking*. The present study failed to find evidence of substantial improvement in question asking for participants of the START intervention program. Although a small increase in question asking was observed on average for the treatment group while the waitlist group showed a slight decrease in question asking, the interaction was not significant, and the effect was small. This is in contrast to prior studies of the START program for adolescents (Ko et al., 2018; Vernon et al., 2016) which found large effect sizes for increases in question asking. Based on this finding, one may wonder if the participants in the present study experienced a significant deficit in question asking prior to beginning the study. As adults, many participants may have previously received substantial intervention, some of which may have targeted question asking. Therefore, it is possible that many participants were already asking an appropriate number of questions. However, Ko et al. (2018) reported that the treatment group was asking over seventeen questions on average prior to intervention, while the adult participants in the present study were asking fewer than five questions on average. Further, as seen in Table 4, the typically developing conversation partners were, on average, asking approximately fourteen questions at the start of this study. Given that the conversation partners were naïve volunteers and were not trained or instructed in question asking behavior, one may conclude that they asked a typical number of questions for socially skilled young adults. Similarly, Ratto et al. (2011) found that typically developing young adults asked 10-15 questions of their conversation partner in a three-minute conversation, while the adults with ASD asked 5-6 questions of their conversation partner, on average. These findings together suggest that question asking remains a

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significant difference in social communication behavior between adults with and without

ASD. It is not clear why the adolescents in the START program were observed to ask far

more questions than the adult participants both before and after intervention, but it may be

the case that the adult oriented START program would benefit from greater focus on

question asking behavior throughout the intervention.

    *Eye contact.* In regard to eye contact, no significant improvement was found in the

treatment group compared to the waitlist group. Surprisingly, both groups appeared to be

making eye contact more than 50% of the time at the initial intake assessment. There are

several possible explanations for this finding. One possibility is that, as adults, it is likely that

many of the participants have been receiving intervention for ASD since they were children

(Green et al., 2006). Because eye contact is a common symptom of ASD and therefore

common intervention goal (Matson & Smith, 2008; Rao, Beidel, & Murray, 2008), it is

possible that the young adults participating in this study had previously worked on this goal

for years and no longer exhibited clinically significant deficits in this social skill, which

would explain the high initial eye contact rates.

    While no studies were identified that have measured eye contact in adults with ASD

in the context of a conversation, one study found that children with ASD look at the face of

their adult conversation partner around 30% of the time compared with 40% for typically

developing children (Nadig, Lee, Singh, Bosshart, & Ozonoff, 2010). Similarly, Klin et al.

(2002) used eye-tracking technology to measure eye gaze patterns in adults with and without

ASD while watching movie clips, and found that adults with ASD look at the actors' eyes

approximately 25% of the time while typically developing adults look at the eyes

approximately 65% of the time. Notably, while Nadig and colleagues defined eye contact as

the participant looking anywhere on the face (as in the present study), Klin and colleagues differentiated between looking at the eyes and other parts of the face. Many studies on face perception have demonstrated that individuals with ASD tend to look more at the mouth or nose, rather than the eyes, while typically developing individuals tend to focus more on the eyes (Dalton et al., 2005; Kirchner, Hatri, Heekeren, & Dziobek, 2011; Spezio, Adolphs, Hurley, & Piven, 2007). Similar to the study by Nadig et al. (2010), for the purposes of this investigation, coders were instructed to code eye contact as any time the participant appeared to be looking at the face of their conversation partner. Therefore, it is possible that, given the ability to track whether the participant was indeed looking at the eyes of their conversation partner or at another part of their face, the results might appear different. It is hoped that with future advances in eye tracking technology, future research may be able to more accurately measure eye contact in the context of social conversations.

*Positive facial expressions.* Results related to positive facial expression, though not statistically significant, did show an encouraging trend toward greater positive affect after completing the START program. This finding is consistent with previous research showing greater positive affect after completing social skills interventions for children, teens, and adults with ASD (Hughes et al., 2011; Koegel et al., 2012). For example, Hughes et al. (2011) investigated the efficacy of a social skills intervention for adolescents and young adults with ASD and co-occurring ID. Participants were taught to initiate social interactions with peers using communication books, and in addition to finding increases in initiations and overall social interaction frequency, they found greater positive affect in the participants, as well as the conversation partners. Notably, neither this study, nor the other studies cited above, explicitly targeted positive affect in the intervention. Though lessons on greetings,

first impressions, showing interest, and using humor may briefly touch on showing positive affect, smiling more during conversations is not an explicit goal of the START program. Rather, as in Koegel et al. (2012), this increase appears to be a collateral gain.

Prior research suggests that increased positive affect may be a result of increased positive social relationships and social motivation (Jakobs et al., 1999; Ramsey & Gentzler, 2015). Ramsay and Gentzler (2015) have asserted that there is a bidirectional relationship between positive social relationships and positive affect, wherein more positive affect strengthens social connections, and conversely, more positive social relationships also lead to more positive affect. It is therefore likely that the process of participating in a social group that is designed to foster fun, closeness, and a sense of belonging would lead to more frequent displays of positive facial expressions. Moreover, this increase in positive affect may lead to the development of more positive social relationships in the future. The clinical importance of this gain is supported by research demonstrating that greater positive affect predicts social relationships and other's perceptions of friendliness and employability (Krstovska-Guerrero & Jones, 2013; Spence, 1981). It must be acknowledged, that it is possible that any social group that meets regularly would have a similar impact on positive affect, and it may not be a direct result of the START protocol specifically, however this remains an encouraging finding.

**Subjective social impression ratings**. In regard to the subjective social impression ratings, analyses revealed no significant group differences after completing the START program, indicating that despite some observable changes in specific conversational behaviors, and despite rating themselves as more socially skilled after the intervention, the overall subjective impression of their social abilities in a five-minute conversation were not

significantly impacted by the 20-week START program. Few previous studies have investigated treatment outcomes using subjective impression ratings. Koegel and Frea (1993) conducted a self-management intervention for children with ASD targeting a variety of social communication behaviors, depending on the needs of each individual child. They collected subjective impression ratings and found that all children improved on their targeted behaviors, as well as subjective ratings of the appropriateness of their social interactions. Similarly, Schreibman, Koegel, Mills, and Burke (1981) evaluated outcomes of ABA therapy for children with ASD and found that children who displayed substantial behavioral changes also showed significant improvements in subjective ratings of social impressions and desirability. Due to mixed results in behavioral outcomes in the present study, observed changes in specific conversation behaviors may not have been sufficient to impact more global subjective social ratings of the participants after completing the START program. As no previous studies were found which evaluated outcomes in adults using subjective social impression ratings, further research is needed.

**Correlations Between Dependent Measures**

Of all the conversation behaviors measured in this study, positive facial expressions most strongly predicted subjective social impression ratings in this sample. Thus, this study adds to extant evidence of the association between positive affect and social perceptions by others. Consistent with previous research demonstrating the association between positive facial affect and subjective ratings of sociability and friendliness (Hughes et al., 2011; Krstovska-Guerrero & Jones, 2013; Spence, 1981), a strong and significant correlation was found between the proportion of intervals in which the participant displayed a positive facial expression and the subjective social impression ratings.

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The present study also revealed associations among some of the conversation behaviors. For example, question asking positively predicted the proportion of intervals in which both conversations partners spoke (turn-taking), and negatively predicted the proportion of intervals in which the participant was the only speaker, indicating that asking more questions led to greater conversational reciprocity and gave the conversation partner more opportunities to contribute to the conversation. Additionally, eye contact was found to correlate with question asking, which is consistent with research showing that eye contact is used to signal turn taking in conversations (Ho et al., 2015). Further, eye contact correlated negatively with intervals in which the participant was the speaker only, and positively with intervals in which the participant was the listener only, suggesting that when participants speak less and listen more, they tend to make more eye contact. These findings are consistent with previous research on typically developing adults which demonstrate that people make more eye contact while listening compared with speaking (Cook, 1977; Fernald, Zangl, Portillo, & Marchman, 2008; Ho et al., 2015). This consistency would suggest that adults with ASD display similar patterns in eye contact as it relates to conversational turn taking.

Surprisingly, the results of this study failed to support the association between subjective social impressions and eye contact, question asking, or conversational balance. These results are inconsistent with the report by Spence (1981) which indicated significant associations between subjective ratings of social ability and eye contact, question asking, and amount spoken. Similarly, these results contradict the study by Minkin et al. (1976) which showed that question asking and proportion of time spent talking significantly predicted subjective ratings of conversational ability. However, Minkin et al. (1976) included only female adolescents and young adults, while participants in the present study were primarily

male. It may be that gender differences influence perception of social skill in conversations. Conversely, Spence (1981) included adolescent boys, which would seem to support consistency across gender for social conversation norms. It may also be the case that social norms and expectations have changed over the past few decades, accounting for divergent results in the present study. Further studies of conversation behavior among adults of all gender identities, as well as those with and without ASD, are needed to clarify the associations between subjective social impressions, eye contact, question asking, conversational balance, and other social communication behaviors.

Additionally, the results of the present study found no significant correlations between the EQ or the SRS-2 and any of the observational measures, subjective or objective. While many studies have demonstrated convergent validity between the SRS-2 and the EQ with numerous other survey measures (Armstrong & Iarocci, 2013; Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004; Takei et al., 2014; Wheelwright et al., 2006), little research currently exists comparing adults' self-report on either of these measures with observational measures. A few studies have demonstrated convergent validity between the SRS, Adult Form (SRS-A) and the ADOS in Japanese and German adult samples (Bölte et al., 2008; Takei et al., 2014), and others have demonstrated convergent validity between parent reports and ADOS scores in children with ASD, but surprisingly, no further studies were identified which compared the SRS-2 adult self-report form with other observational measures. Similarly, the EQ has been shown to correlate with the Eyes Test, a performance-based measure of emotion recognition (Lawrence et al., 2004), and the EQ has been shown to predict ASD diagnosis with good accuracy (Baron-Cohen & Wheelwright, 2004), however further research is needed to clarify the extent to which this measure corresponds with

observable behaviors. As Bruni (2014) points out, "the utility of the SRS-2 [or any survey measure] depends on the accuracy of the rater," (p. 368). Prior research has suggested that self-report measures completed by individuals with ASD about their own social abilities ought to be interpreted with caution (MacKay et al., 2007; Mazefsky et al., 2011; Tse et al., 2007; Vernon et al., 2016).

Nevertheless, if one's perceptions of one's own abilities allows one to feel more confident interacting with others, and if increased practice in social situations is likely to lead to improved social performance, then perhaps improved self-perceptions may predict better long-term outcomes on observational measures. Prior studies have supported the idea that perceiving one's self as socially incompetent leads to social anxiety, which in turn leads to social avoidance and isolation (Bellini, 2006; Weeks, Rodebaugh, Heimberg, Norton, & Jakatdar, 2009). In conjunction with evidence of the importance of experiential learning for social skill development (e.g. DeMatteo et al., 2012), social isolation is likely to be detrimental to social development in individuals with ASD. Further research and follow-up data may provide a clearer picture of the clinical implications of improvements on self-report measures of adults with ASD.

**Implications**

This research study adds to the current literature in a number of ways. Firstly, this is among the first RCTs of a social skills group for adults with ASD. A review of the literature revealed two publications which report the results of controlled efficacy studies of a social skills group for adults with ASD, both of which investigated the efficacy of the Program for the Education and Enrichment of Relational Skills (PEERS®), a caregiver assisted social skills group for young adults with ASD (Gantman et al., 2012; Laugeson et al., 2015). Both

studies found significant improvements on self- and parent-reported social skill, social engagement, empathy, loneliness, and ASD symptoms after completing the program. Importantly, neither of these published investigations included any live observational measures of actual participant social skill use. Conversely, Howlin and Yates (1999b) measured outcomes of their social skills group for adults with ASD using behavioral observation of social communication behaviors. However, that study did not include a rigorous research design with a control group, nor did it include safeguards to mitigate observer bias, such as ensuring observers were naïve to the time point of observed samples. Two currently published investigations of the START intervention for adolescents (Ko et al., 2018; Vernon et al., 2016) did control for such biases in assessing the efficacy of START for adolescents with promising results, however this is the first study to our knowledge that used masked behavioral coders within the context of an RCT to determine the impact of a social skills group for young adults with ASD.

Furthermore, the current study presented the unique opportunity to re-examine the associations between self-report, objective observational, and subjective observational measures. Spence (1981) appears to be the most recent study which specifically investigated associations between specific social behaviors and subjective ratings of social skill and desirability, and as described above, few studies have investigated associations between self-report and behavioral measures of social communication in adults with ASD. Therefore, this study further contributes to a current understanding of how the verbal and nonverbal social communication behaviors measured here predict subjective social impressions. The results of the present study additionally suggest that further research is needed to understand the

broader implications of changes on self-report measures following intervention for adults with ASD.

**Limitations and Future Directions**

The present study provided preliminary data on a variety of outcome measures to test the impact of the START program for young adults with ASD, and due to small group sizes, all results must be interpreted with caution. In addition to the expected attrition due to participants not meeting inclusion criteria, or participants dropping out of the intervention due to scheduling conflicts, additional video data was lost during the file transfer process. While some effects were large enough to be detected with the available sample size, other smaller effects would require far larger groups. For example, post-hoc power analyses with effect size data obtained from this investigation revealed that detection of differences for the question asking variable would require 48 participants, while detecting differences in eye contact would require a sample size of 126 participants. Continued investigation of the START intervention for young adults is warranted with larger sample sizes to further elucidate intervention effects.

Additionally, racial and gender diversity was limited in the present sample. The majority of participants in the present study were male, although this gender imbalance is typical for the autism population considering that males are more frequently diagnosed with ASD than females (Loomes, Hull, & Mandy, 2017). However there remains a significant proportion of the ASD population who are female or identify with other gender categories (e.g. transgender, nonbinary, etc.). It is important that researchers continue to make efforts to include individuals of all gender identities in intervention research. Additionally, the majority of participants in this study were white and non-Hispanic, with a few identifying as Hispanic,

Asian, Middle Eastern, or multiracial. Similarly, all subjective raters were female and two of the three were white. It would be valuable in future research to include a more diverse group of participants, as well as more diverse subjective raters to provide more representative views regarding what behaviors predict better or worse social impressions. Culture has a strong influence on social norms and expectations (Buchan, Johnson, & Croson, 2006), which can shape performance and perceptions of social communication behaviors. Therefore, in addition to larger group sizes, more diversity in group participants may yield different results. Larger, multisite trials may be helpful in capturing more representative samples of individuals with ASD.

Similarly, the present study exclusively targeted individuals with relatively low support needs (i.e. "high-functioning" autism), as opposed to targeting individuals with ASD with moderate to high support needs. While research supports the importance of grouping participants by skill level (Krasny et al., 2003), it is also important to continue developing effective interventions for adults with ASD across all levels of support needs, including those with more severe social communication challenges, co-occurring intellectual disability, etc. Notably, in addition to the inclusion criteria for the present study requiring individuals have a verbal IQ above 70, intake assessment data showed that both groups rated themselves as minimally impaired on self-report measures of social responsiveness and empathy prior to the intervention. Therefore, it is not known how this intervention would impact a more severely impaired group of adults. Further investigation into the impact of the START program on adults with greater social challenges is warranted.

Further, although many outcome variables were measured in the present study, many others were not. Because the present study focused on quantitative rather than qualitative

information, data was not collected on the conversation topics or the appropriateness of verbal or nonverbal behaviors such as questions asked or facial expressions as they relate to the context of the conversation. For example, in regard to positive facial expressions, the extent to which the participants' facial expressions were appropriate to the content of the conversation was not measured, limiting the conclusions that can be drawn about that behavior. It may be noted that because observations were based on five-minute conversations with a stranger, it seems unlikely that conversation partners shared deeply personal or upsetting information that would make positive facial expressions appear inappropriate to the context. Furthermore, the finding that there were strong and significant correlations between the proportion of intervals containing positive facial expressions and the subjective impressions support the assumption that the positive facial expressions were appropriate to the context. However, this limitation brings the possibility of alternative explanations. In the preliminary investigation of the START program for teens with ASD (Vernon et al, 2016), some of the participants were identified as making too many negative statements prior to intervention, and therefore worked on the individualized goal of reducing negative statements. Participants for whom that behavior was targeted and measured were found to make fewer negative statements over the course of the intervention. Other studies have also targeted reducing negative statements and increasing positive statements in adults with ASD (Koegel et al., 2015). Because individual goals were not accounted for in the present analyses, it is not clear how many participants in the treatment group were targeting negative statements in intervention, nor whether that behavior changed for a substantial number of participants. It is therefore unclear whether the increase in positive facial expressions reflect greater social engagement and motivation, greater alignment between internal experience and

external expression, more positive and less negative content of conversations, or some combination of these factors.

Of the social conversation behaviors that were analyzed, it is also important to note some limitations in the data collection methods. For example, as noted previously, eye contact was defined as any time the participant appeared to look at their conversation partner's face. Given prior research suggesting that adults with ASD may tend to look at parts of the face other than the eyes, the results of the present study may be limited by the inability to distinguish what part of the face the participant was looking at. Future studies may benefit from the use of more precise recording and measurement devices, and camera angles must be considered in future research when collecting video samples. Additionally, because conversational balance and positive facial expressions were measured in three second intervals, some information is not available. For example, intervals were coded as containing a positive facial expression or not, however the intensity and duration of the positive facial expression is not known. Future studies may benefit from coding this variable as continuous, and also coding expressions on a wider scale, from very negative, to neutral, to very positive. Although that method would introduce more subjectivity, it may also yield richer data. Similarly, for conversational balance, intervals were coded as either one person speaking, the other person speaking, both, or neither. However, the precise amount spoken by each person in each interval is not known. While this method provided a good estimate of the distribution of speech per conversation partner, future studies may benefit from analyzing the exact number of words or duration of each person's speech. Voice recognition software may also be a useful tool for analyzing conversational balance in future studies.

Finally, while the use of a wide variety of volunteers rather than study confederates as conversational partners adds to the external validity of the results, this lack of control for the behavior of conversation partners also may create additional variability in the conversational behaviors of participants. For example, if one conversation partner is especially energetic and talkative, as compared with a conversation partner who is tired, in a bad mood, or otherwise less engaging for any reason, this could impact the performance of the participant. This potential confound was partially controlled for by using two different conversation partners at each time point, however this factor must also be considered when interpreting the results of this study. With these limitations in mind, the promising results of the present study warrant further investigation.

Given the limited availability of evidence-based social skill interventions for adults with ASD (Bishop-Fitzpatrick et al., 2013; Shattuck et al., 2012; Wong et al., 2015), it is crucial to continue the development and investigation of effective methods for improving social skills and long term outcomes for adults with ASD. Consistent with the well-established efficacy of social skills group interventions for children and adolescents with ASD (Reichow & Volkmar, 2010), this study provides added support for the potential benefit of social skills groups for adults with ASD. However, the present study also reveals a need for more research on how to predict and enhance social success for adults in general. Gaining a better understanding of what social communication behaviors are most strongly related to subjective social impressions will help guide the development of effective social skills intervention for individuals with ASD. Targeting behaviors that are most likely to impact subjective social impressions will ultimately help individuals with ASD be more successful in their social interactions.

**Conclusion**

Overall, analyses suggest that the START program for young adults with ASD leads to significant changes in conversational balance and reciprocity, modest changes in positive facial expression, and negligible changes in eye contact or question asking. Although trends appear in the expected direction for all of these behaviors, there was substantial variability across participants in each group, and larger sample sizes may provide clarity regarding the impact of the START program on those social communication behaviors. The present study also found changes in self-reported social abilities for those who completed the START program, but no changes in subjective social impression ratings by naïve observers. Further research is needed to clarify the full impact of the START program on adults with ASD, as well as the associations between self-report measures, objectively quantified behaviors, and subjective social impressions in adults with ASD.

Social communication is key to academic, vocational, and social success, and because of that, adults with ASD often struggle in those areas. Tremendous strides have been made in early intervention for children on the autism spectrum, but adults remain under-studied and under-served. The development of effective interventions to support adults with ASD in their social development is essential for supporting the future success of those individuals. Given the lack of evidence-based social skill interventions for adults on the autism spectrum, this study adds to existing evidence indicating the utility of group-based interventions that target social communication and socialization skills. The present study also points to the need to measure outcomes using a variety of tools and perspectives in order to fully understand the impact of interventions. Group based, peer-mediated interventions provide a promising option for building social skills in an ecologically valid way that can address both knowledge

and performance deficits and facilitate generalization and dissemination. Further research is

needed to understand how best to meaningfully target social communication in ways that will

help adults with ASD live happy and successful lives.

## V. Tables

**Table 1. Participant Demographic Information**

|  | Treatment | Waitlist | $p$ |
|---|---|---|---|
| Age | 20.8 (SD=2.6) | 21.1 (SD=2.7) | 0.805 |
| % Male | 90.0% | 66.7% | 0.193 |
| % White | 60.0% | 58.3% | 0.937 |
| Verbal IQ | 104.7 (SD=25.2) | 101.7 (SD=16.5) | 0.738 |
| Nonverbal IQ | 108.6 (SD=20.0) | 108.2 (SD=11.8) | 0.950 |
| Composite IQ | 107.8 (SD=23.1) | 106.2 (SD=15.0) | 0.843 |

**Table 2. Weekly Group Discussion Topics**

| Week | Topic |
|---|---|
| 1 | Greetings, First impressions |
| 2 | Showing interest |
| 3 | Questions, Comments |
| 4 | Choosing and changing topics of conversation |
| 5 | Saying goodbye |
| 6 | Identifying peer groups and potential friends |
| 7 | Social Courage |
| 8 | Social Media and cell phones |
| 9 | Perspective taking and empathy |
| 10 | Maintaining relationships |
| 11 | Living with others |
| 12 | Humor and sarcasm |
| 13 | Social feedback |
| 14 | Dating, Part 1: First contact |
| 15 | Dating, Part 2: On a date |
| 16 | Professional communication |
| 17 | Respectfully disagreeing |
| 18 | Working as part of a group or team |
| 19 | Applying and interviewing for jobs |
| 20 | Conduct at work / Wrap-up session |

**Table 3. Inter-Rater Reliability**

| Behavior | Percent Agreement | Cohen's Kappa |
|---|---|---|
| **Eye Contact** | 82% | 0.68 |
| **Positive Facial Expression** | 87% | 0.53 |
| **Question Asking** | 91% | 0.66 |
| **Conversational Balance** | 85% | 0.76 |

**Table 4. Mean number of questions asked by group at each time point**

| | Pre<br>Mean (SD) | Post<br>Mean (SD) |
|---|---|---|
| Treatment Group | 4.55 (4.39) | 5.23 (3.11) |
| Waitlist Control Group | 4.50 (4.27) | 4.21 (4.01) |
| Typically Developing Conversation Partners | 13.82 (6.89) | 11.68 (7.11) |

**Table 5. Summary of results for all RCT outcome measures.**

| Variable | Treatment (n = 10) | | Waitlist (n = 12) | | Group x Time | |
|---|---|---|---|---|---|---|
| | Pre M (SD) | Post M (SD) | Pre M (SD) | Post M (SD) | $p$-value | partial η2 |
| SRS-2 Total T-Score | 60.80 (11.72) | 56.50 (8.50) | 64.58 (9.74) | 67.58 (11.00) | 0.026* | 0.223 |
| EQ Total Score | 32.80 (11.84) | 39.90 (10.50) | 28.42 (10.33) | 29.92 (10.22) | 0.084 | 0.141 |
| Percent of Time Making Eye Contact | 55.41 (23.02) | 59.71 (18.08) | 59.91 (22.74) | 61.39 (20.60) | 0.575 | 0.017 |
| Percent of Intervals with Positive Facial Expressions | 23.20 (16.65) | 32.45 (18.10) | 25.96 (17.11) | 27.19 (17.65) | 0.081 | 0.152 |
| Number of Questions Asked | 4.55 (4.39) | 5.23 (3.11) | 4.50 (4.27) | 4.21 (4.01) | 0.351 | 0.044 |
| Percent of Intervals in which the Participant was… | | | | | | |
| *Speaker Only* | 34.46 (10.54) | 27.54 (9.36) | 26.23 (12.39) | 33.11 (17.18) | 0.001** | 0.430 |
| *Listener Only* | 24.73 (7.57) | 28.78 (10.31) | 32.52 (12.60) | 27.63 (12.80) | 0.018* | 0.248 |
| *Both* Speaker and Listener | 38.66 (8.65) | 41.94 (6.77) | 37.89 (6.36) | 35.18 (9.86) | 0.107 | 0.125 |
| *Neither* Speaker nor Listener | 2.10 (1.06) | 1.78 (0.91) | 2.30 (1.02) | 2.03 (0.98) | 0.619 | 0.013 |
| Subjective Social Impression Ratings | 26.95 (5.33) | 28.02 (4.41) | 22.29 (5.61) | 23.43 (6.89) | 0.950 | <0.001 |

*p<0.05
**p<0.01

**Table 6. Correlation Results: R values**

|  | SRS | EQ | EC | PFE | QA | Speaker | Listener | Both | Neither |
|---|---|---|---|---|---|---|---|---|---|
| **EQ** | -.683** | | | | | | | | |
| **EC** | -0.213 | -0.167 | | | | | | | |
| **PFE** | 0.216 | -0.176 | -0.163 | | | | | | |
| **QA** | -0.189 | -0.156 | .469* | -0.161 | | | | | |
| **Speaker** | 0.181 | 0.054 | -.484* | -0.118 | -.525* | | | | |
| **Listener** | -0.086 | -0.002 | 0.421 | -0.046 | 0.214 | -.729** | | | |
| **Both** | -0.170 | -0.078 | 0.187 | 0.228 | .529* | -.569** | -0.144 | | |
| **Neither** | 0.163 | 0.219 | -0.175 | -0.054 | -0.419 | 0.427 | -0.389 | -0.229 | |
| **SSIR** | -0.185 | 0.163 | -0.040 | .591** | 0.129 | 0.052 | -0.144 | 0.132 | -0.316 |

Key: Social Responsiveness Scale (SRS), Empathy Quotient (EQ), Eye Contact (EC), Positive Facial Expression (PFE), Question Asking (QA), Percent of intervals in which participant was the speaker only (Speaker), Percent of intervals in which participant was the listener only (Listener), Percent of intervals in which participant was both speaker and listener (Both), Percent of intervals in which participant was neither conversation partner spoke (Neither), Subjective Social Impression Rating (SSIR).

Note: Gray cells indicate interrelated variables related to conversational balance.

*p<0.05

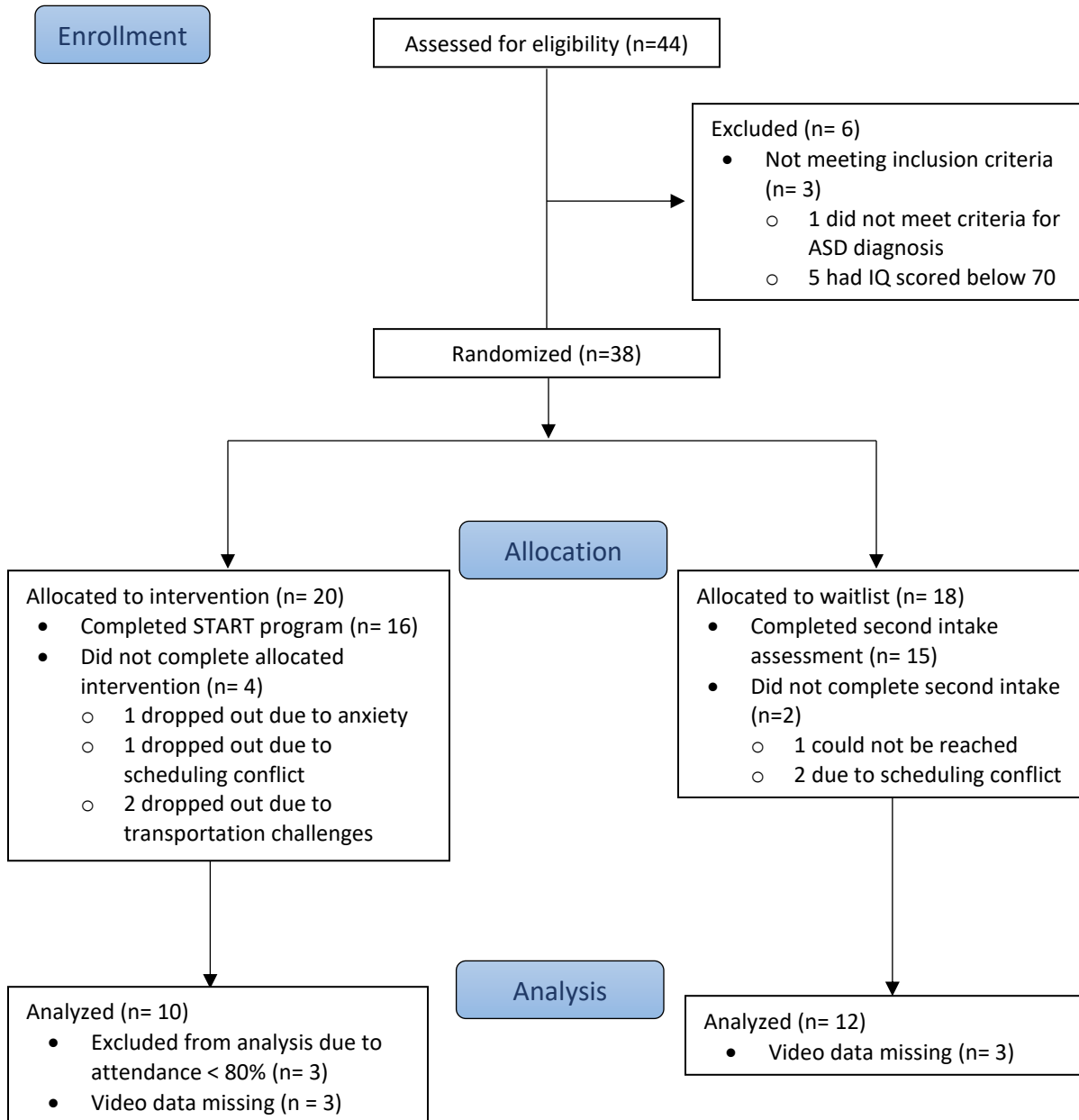**p<0.01

## VI. Figures

**Figure 1. CONSORT flow chart**

Enrollment

Assessed for eligibility (n=44)

Excluded (n= 6)
- Not meeting inclusion criteria (n= 3)
  - 1 did not meet criteria for ASD diagnosis
  - 5 had IQ scored below 70

Randomized (n=38)

Allocation

Allocated to intervention (n= 20)
- Completed START program (n= 16)
- Did not complete allocated intervention (n= 4)
  - 1 dropped out due to anxiety
  - 1 dropped out due to scheduling conflict
  - 2 dropped out due to transportation challenges

Allocated to waitlist (n= 18)
- Completed second intake assessment (n= 15)
- Did not complete second intake (n=2)
  - 1 could not be reached
  - 2 due to scheduling conflict

Analysis

Analyzed (n= 10)
- Excluded from analysis due to attendance < 80% (n= 3)
- Video data missing (n = 3)

Analyzed (n= 12)
- Video data missing (n= 3)

**Figure 2. Mean SRS-2 adult self-report total T-scores.**
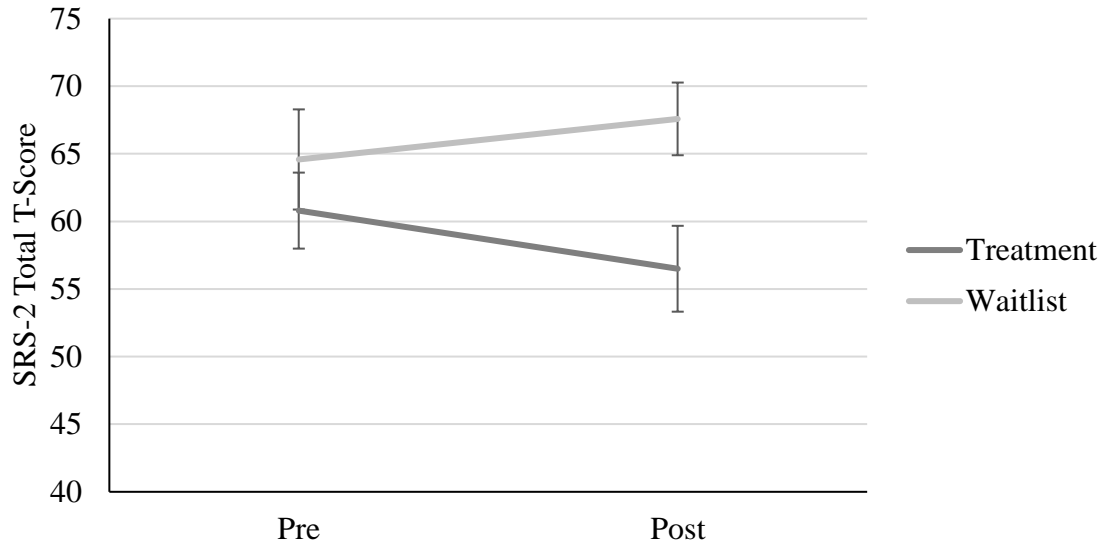


**Figure 3. Mean EQ scores.**
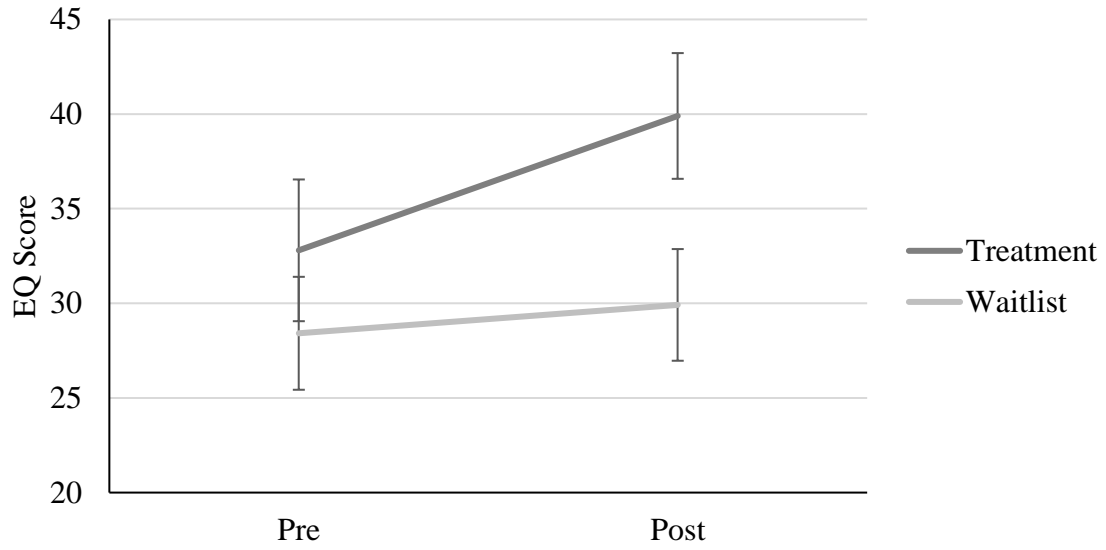
**Figure 4. Mean percent of five-minute conversations during which were looking at the face of their conversation partner.**
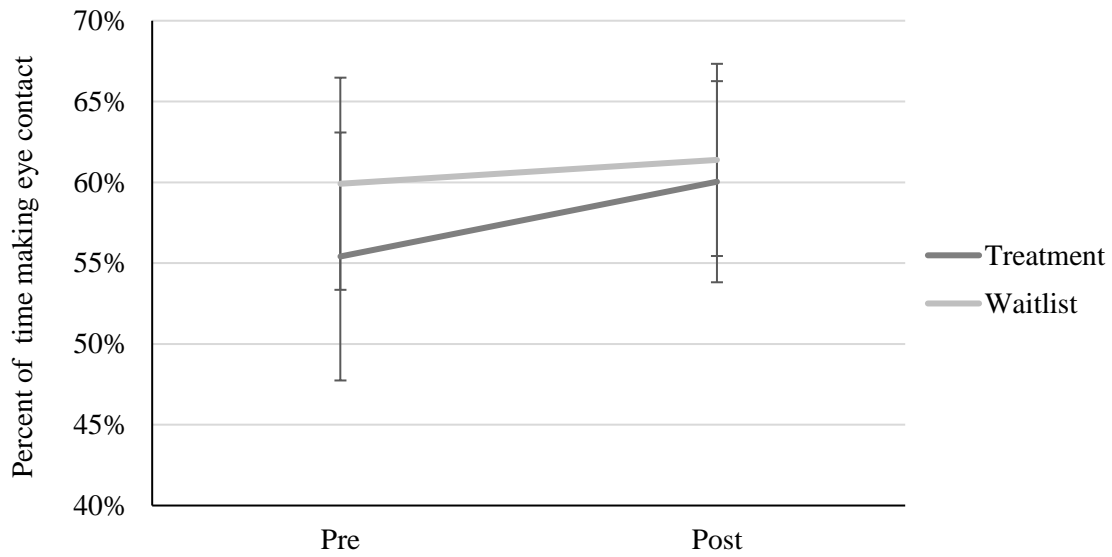


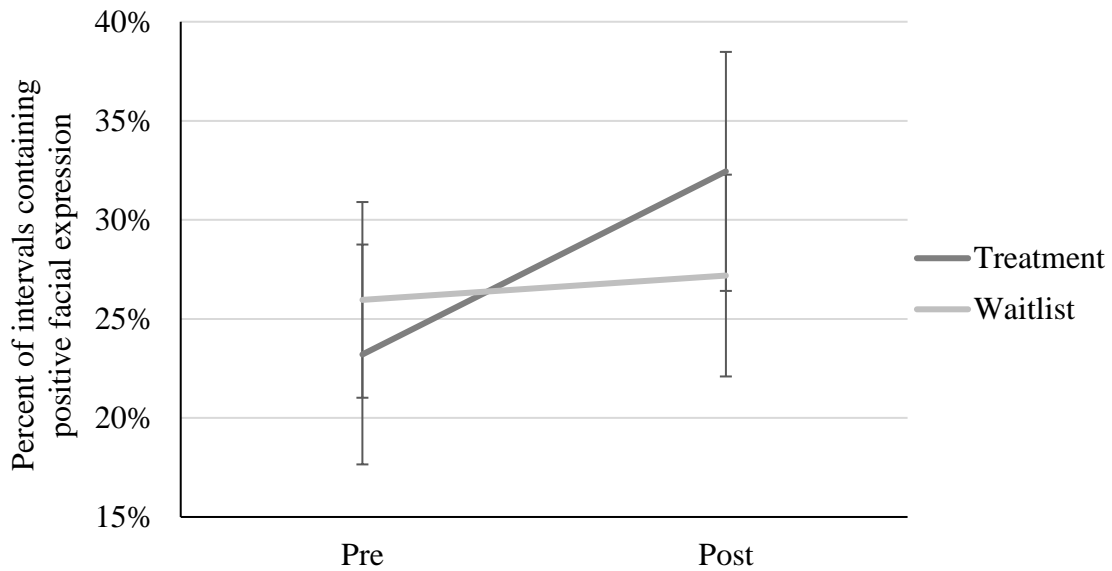**Figure 5. Mean percent of intervals in which participants displayed a positive facial expression.**
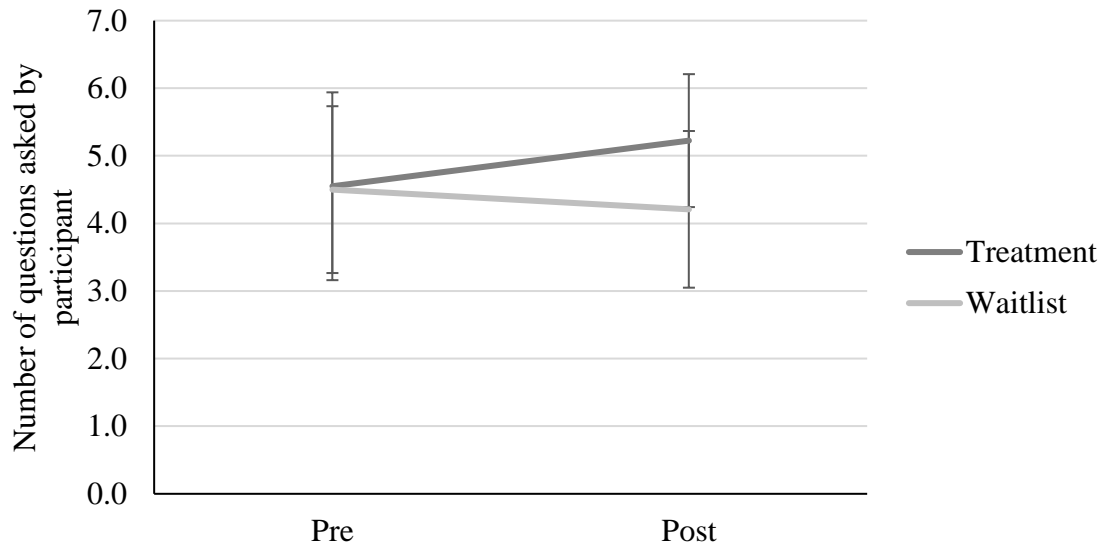
**Figure 6. Mean number of questions asked by participants.**



**Figure 7. Mean percent of intervals in which the participant was the speaker only.**
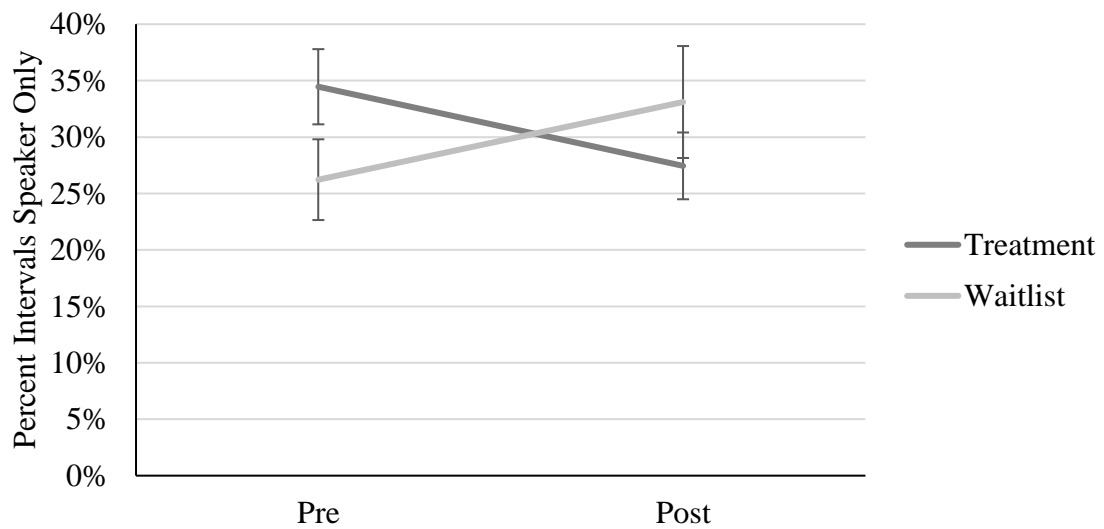
**Figure 8. Percent of intervals in which the participant was the listener only (i.e. only the conversation partner spoke).**
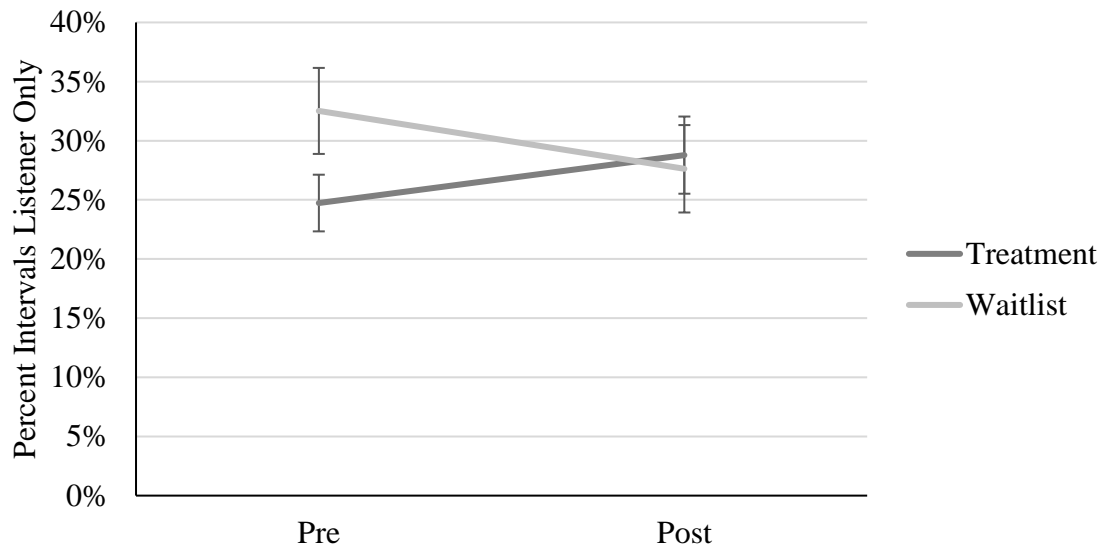


**Figure 9. Percent of intervals in which the participant was both speaker and listener (i.e. both the participant and their conversation partner spoke).**
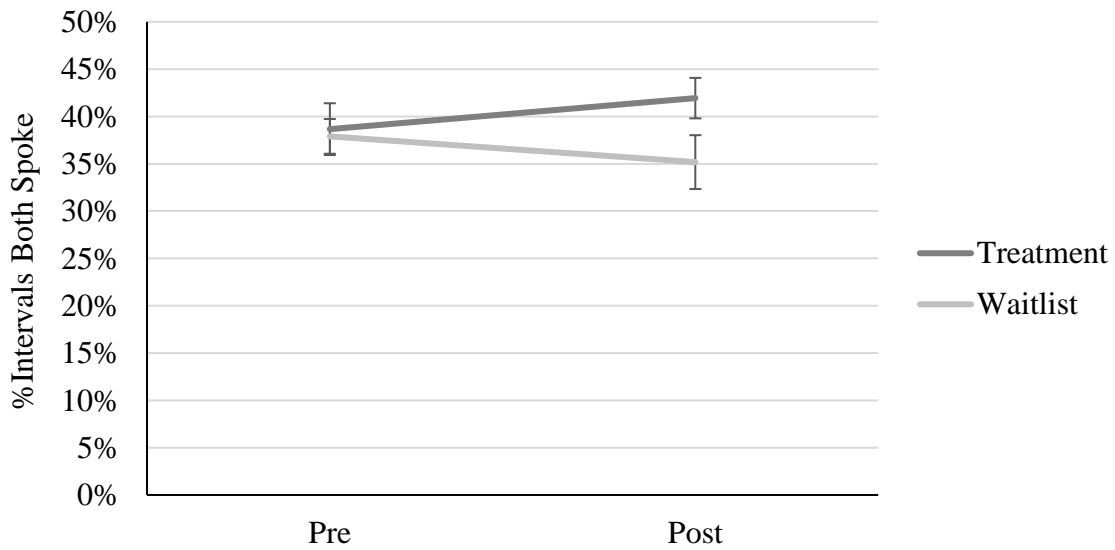
**Figure 10. Percent of intervals in which the participant was neither the speaker nor the listener (i.e. neither the participant nor their conversation partner spoke).**
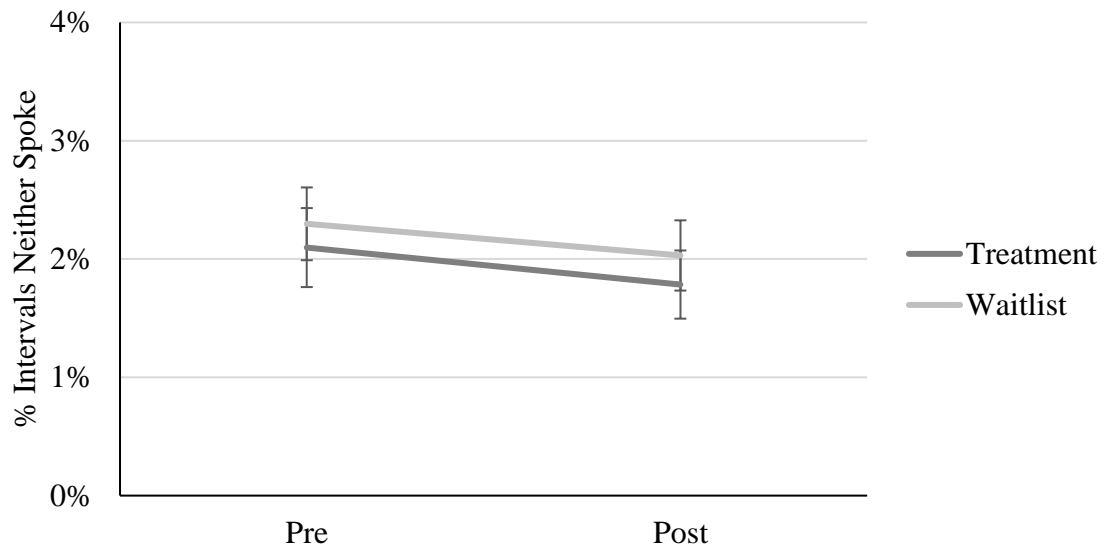


**Figure 11. Mean difference score between intervals in which the participant was the speaker only or listener only.**
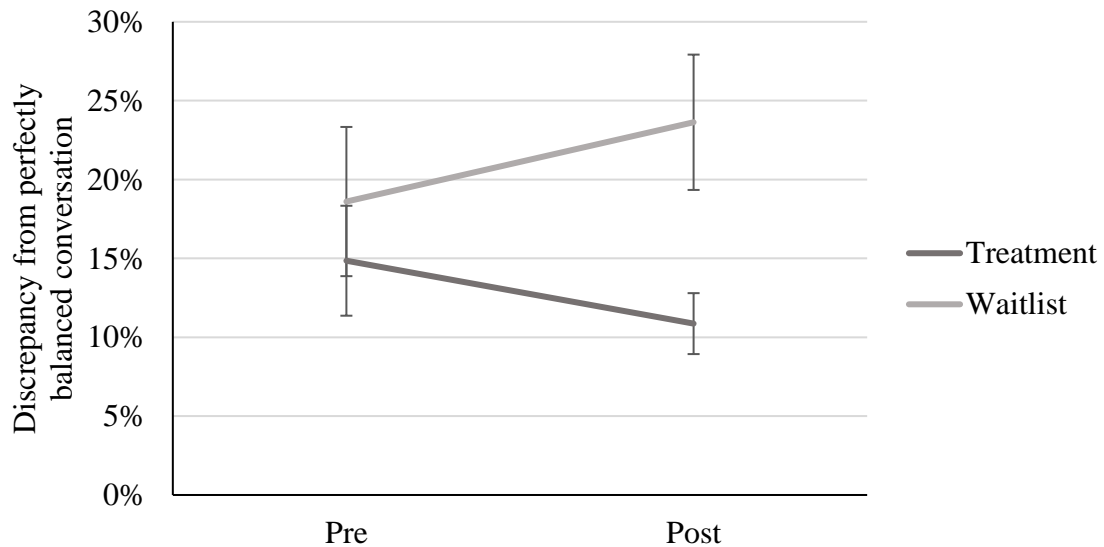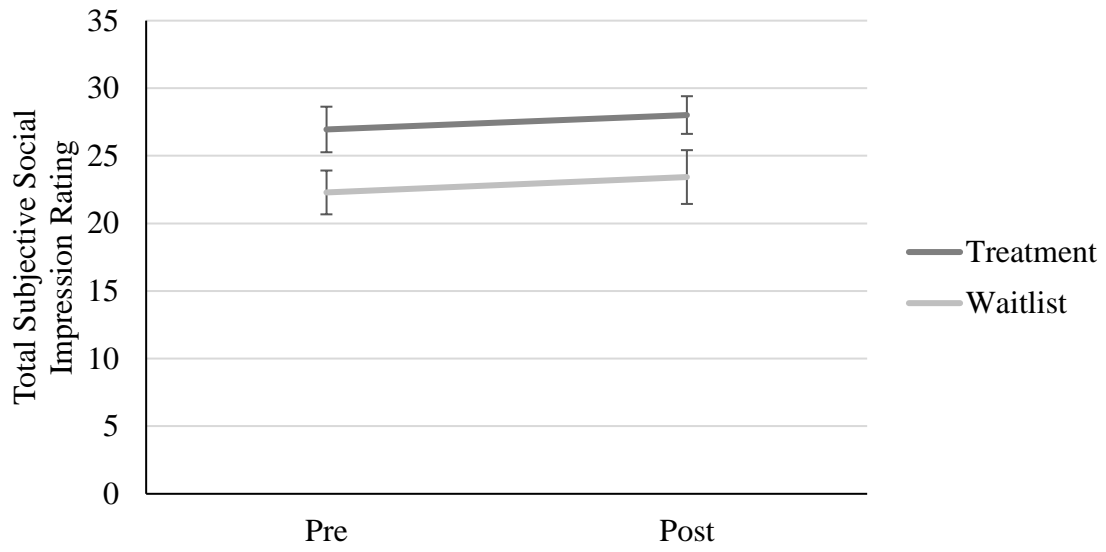
**Figure 12. Mean subjective social impression ratings for each group.**

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