

6-30-2015

Social Functioning in Individuals with a History of Autism Spectrum Disorders Who Achieved Optimal Outcomes

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Social Functioning in Individuals with a History of Autism Spectrum Disorders Who Achieved

Optimal Outcomes

Alyssa Orinstein, Ph.D.

University of Connecticut, 2015

Autism spectrum disorders (ASDs) were once considered lifelong disorders, but recent findings indicate that some children with ASDs no longer meet diagnostic criteria for any ASD and reach normal cognitive function. The current study examined social functioning in 24 of these individuals (ages 8-21), called 'optimal outcome' (OO), who did not differ on age, sex, and nonverbal IQ to 29 individuals with high-functioning autism (HFA) and 26 typically developing (TD) individuals. The groups were compared on a measure of other psychiatric disorders that have symptoms which may result in social difficulties and on a measure of overall likability. Results indicated that the HFA group scored worse than the OO and TD groups on domains of withdrawal/depression, immaturity, attention problems, and self-control problems. The OO group, in turn, displayed more difficulties with immaturity, attention problems, and self-control problems than the TD group. However, the OO group was rated by peers to be at least as likable as the TD participants, and were even rated as friendlier, warmer, and more approachable. The HFA group, on the other hand, was rated by peers to be less likable in all aspects than the OO and TD participants. These data suggest that OO individuals have no readily observable social skill deficits, at least when interacting with a trained adult. However, the presence of more difficulties with immaturity, attention problems, and self-control problems in the OO adolescents indicate that they are exhibiting mild social difficulties which are more consistent with those seen in attention-deficit/hyperactivity disorder (ADHD) than in autism spectrum disorders (ASDs).

Social Functioning in Individuals with a History of Autism Spectrum Disorders Who Achieved
Optimal Outcomes

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A Dissertation

Submitted in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy
at the
University of Connecticut

2015

APPROVAL PAGE

Doctor of Philosophy Dissertation

Residual Communication and Social Deficits in Individuals with a History of Autism Spectrum
Disorders Who Achieved Optimal Outcomes

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Acknowledgements

I would like to thank my advisor, Deborah Fein, my committee members, Inge-Marie Eigsti, and Michael Stevens, and my readers, Marianne Barton and Kimberli Treadwell, for their knowledgeable input and support. I greatly appreciate the rest of the Optimal Outcome laboratory, including the graduate students, Molly Helt, Michael Rosenthal, Joyce Suh, Eva Troyb, and Katherine Tyson, for collecting the data and helping me through this process. Additionally, I am grateful for all of our undergraduate research assistants, who entered all of the data and assisted with scoring the measures. Finally, the study could not have been conducted without participants; therefore, I would like to thank all the adolescent and families who participated in our study. This study was supported by the National Institutes of Mental Health grant R01MH076189.

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Autism spectrum disorders (ASDs) are characterized by impairment in social interaction, impairment in communication, and restricted, repetitive, or stereotyped interests or behaviors (American Psychiatric Association, 2000). According to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR), the autism spectrum consists of Autistic Disorder, Asperger's Syndrome, and Pervasive Developmental Disorders-Not Otherwise Specified (PDD-NOS). A diagnosis of Autistic Disorder indicates that symptoms are present from each of the three categories. PDD-NOS and Asperger's Disorder are characterized by fewer symptoms than is required for an Autistic Disorder diagnosis (American Psychiatric Association, 2000).

ASDs are generally considered lifelong disorders; however, even the earliest studies of adolescents and adults with ASDs showed evidence of change in symptomatology over time (DeMyer et al., 1973; Rutter, Greenfield, & Lockyer, 1967). Most studies of the autism phenotype in adolescence and adulthood have demonstrated abatement of symptoms from early childhood (Burd et al., 2002; Gilchrist et al., 2001; Mesibov, Schopler, Schaffer, & Michal, 1989; Rutter et al., 1967), with improvements most frequently occurring during the pre-adolescent through early adolescent period (Kobayashi, Murata, & Yoshinaga, 1992). More significant improvement also occurs most commonly in individuals with higher IQs (McGovern & Sigman, 2005).

Social Deficits and Abnormalities in Adolescents and Adults with ASDs

Studies of ASDs have typically shown an overall improvement in the social domain (Fecteau, Mottron, Berthiaume, & Burack, 2003; Piven, Harper, Palmer, & Arndt, 1996). A substantial portion of adolescents and adults with ASDs do not display many of the inappropriate social behaviors typical of younger individuals with ASDs, including using others' bodies as

tools, making atypical social overtures, and being unable to comfort others. Skills that are likely to remain impaired include engaging in reciprocal social interactions, forming and maintaining relationships, sharing enjoyment with others, making appropriate eye contact, and showing a range of or appropriate facial expressions (Howlin, Mawhood, & Rutter, 2000; Seltzer et al., 2003).

Friendship quality has also consistently remained impaired in adolescence and adulthood in individuals with ASDs (DeMyer et al., 1973; Howlin, 2003; Howlin et al., 2000; Orsmond, Krauss, & Seltzer, 2004; Shattuck et al., 2007; Whitehouse, Watt, Line, & Bishop, 2009). There has been a range in the number of individuals who are reported to eventually develop some kind of friendships. Some studies have reported very low percentages, ranging between 0 and 15.8% (DeMyer, et al., 1973; Howlin, 2003; Howlin, et al., 2000; Orsmond, Krauss, & Seltzer, 2004; Shattuck et al., 2007; Whitehouse, et al., 2009). However, Eaves and Ho (2008) had more promising findings, with 33% of the young adults with ASD in their study reporting at least one close friendship that involved connectedness and mutual enjoyment. Seltzer et al. (2003) found that quantity and quality of friendships was very unlikely to change over time, as only 4.4% who did not have true friendships between the ages of ten and fifteen did so at the time of the study (mean age of 22). Shattuck et al. (2007) had similar findings in that the increase of individuals with ASD who had friendships was only 7.5% over a period of four-and-a-half years.

Pragmatic Language Deficits in Adolescents and Adults with ASDs

As with social skills, studies indicate a trend for overall improvement in social and communicative aspects of language (Ballaban-Gil, Rapin, Tuchman, & Shinnar, 1996; Piven et al., 1996). Some communication deficits are more likely to fully remit with age in individuals with ASDs, including use of idiosyncratic language (Seltzer et al., 2003). Other skills may

improve but are likely to remain impaired, such as nonverbal communication, atypical prosody, stereotyped or repetitive language, and asking inappropriate questions (Gilchrist et al., 2001; Seltzer et al., 2003).

Difficulties with pragmatic language, or the social uses of language, often continue throughout the lifespan in individuals with ASDs (Whitehouse et al., 2009). Adolescents and adults with high-functioning ASDs, compared to controls, demonstrated a weaker ability to interpret nonliteral statements and have trouble providing contextually appropriate answers (Jolliffe & Baron-Cohen, 1999). Ozonoff and Miller (1996) found impaired ability to make inferences and decreased comprehension of indirect requests in adolescents and young adults with high-functioning ASDs. Deficiency in understanding and appreciating humor, including cartoons and jokes, has also been noted in individuals with high-functioning ASD relative to controls (Emerich, Creaghead, Grether, Murray, & Grasha, 2003; Ozonoff & Miller, 1996). Additionally, adolescents and young adults tend to perform poorly on standardized tests and clinician rating scales of pragmatic language (Freitag, Kleser, & von Gontard, 2006; Landa & Goldberg, 2005; Lewis, Murdoch, & Woodyatt, 2007; Minshew, Goldstein, & Siegel, 1995; Young, Diehl, Morris, Hyman, & Bennetto, 2005).

Because of difficulties with pragmatic language and socialization, individuals with high-functioning ASDs are generally impaired in their spontaneous speech and conversational ability. In a study with adolescents and young adults, Freitag et al. (2006) used a standardized measure of spontaneous speech and found that the individuals with high-functioning ASDs were impaired in their communicative behavior, articulation and prosody, and semantic and syntactic structure. Eales (1993) found impairment of relevant communicative intentions and more inappropriate, stereotyped language use during a conversational task in young adults with high-functioning

ASD relative to individuals with developmental receptive language disorder. Additionally, adolescents with high-functioning ASDs more frequently referred to the physical environment in conversation and less frequently referred to previous topics of conversation (Fine, Bartolucci, Szatmari, & Ginsberg, 1994). Children and adolescents with high-functioning ASD also tended to use more idiosyncratic language and neologisms (made-up words) than controls, impeding their conversational ability (Volden & Lord, 1991).

Several recent studies have utilized a version of the Pragmatic Rating Scale (PRS; Landa et al., 1992) to examine social interaction behaviors in individuals with high-functioning ASD. The PRS was initially developed to examine weaknesses in pragmatics in family members of children with ASDs. Therefore, the PRS seems to be an ideal instrument to assess even relatively mild pragmatic difficulties. Compared to typically developing peers, adolescents ages 12 through 18 with high-functioning ASD were more likely to have difficulty with topic management and reciprocity, have unusual speech characteristics, and use less appropriate gaze, facial expressions, and gestures (Paul, Orlovski, Marcinko, & Volkmar, 2009). A more recent study with slightly younger children, ages 8 through 15, had similar findings, noting that the participants with high-functioning ASD failed to take turns appropriately in conversation, perseverated on topics of interest, failed to clarify ambiguities, and engaged in odd social behaviors, such as bowing (Lam & Young, 2012).

Prosody is also often atypical in high-functioning individuals with ASDs. Shriberg et al. (2001) found a greater prevalence of speech-sound distortions, including more inappropriate or non-fluent phrasing, inappropriate placement of stress within the utterance, and utterances rated as nasal in individuals with high-functioning ASDs relative to controls. Other studies have also noted abnormal prosody in adolescents and young adults with high-functioning ASDs, including

greater variation of intonation (Diehl, Watson, Bennetto, McDonough, & Gunlogson, 2009) and inappropriate stress and duration of syllables (Paul, Bianchi, Augustyn, Klin, & Volkmar, 2008). Furthermore, research has found that while children and adolescents with high-functioning ASDs may be able to somewhat adjust their voice register depending on the situation, they are not as adept at this skill as their typically developing peers (Volden, Magill-Evans, Goulden, & Clarke, 2007; Volden & Sorenson, 2009). These speech difficulties combine to negatively impact the ability of individuals with ASDs to engage in social interactions.

Psychiatric Comorbidity in Adolescents with ASDs

Previous research suggests that adolescents with ASDs, in addition to symptoms specific to ASDs, also exhibit high rates of comorbid psychiatric disorders (Canitano & Vivanti, 2007; Gjevik, Eldevik, Fjaeran-Granum, & Sponheim, 2011; Joshi et al., 2010; Mattila et al., 2010; Munesue et al., 2008; Muris, Steerneman, Merckelbach, Holdrinet, & Meesters, 1998; Simonoff et al., 2008). When compared to estimated prevalence rates for psychiatric disorders in typically developing United States individuals (Kessler et al., 2009), adolescents with ASDs tend to show higher rates of psychopathology.

The term comorbidity refers to the presence of two or more symptomatically distinct psychiatric disorders that are present at the same time in an individual. In the case of ASD, which has complex and heterogeneous presentations, however, there is difficulty distinguishing between comorbidity and overlapping syndromes (e.g., ASDs versus ADHD). Not only do ASDs overlap behaviorally with other disorders, but ASDs and comorbid disorders may be uniquely related through underlying pathophysiology (Gillberg & Billstedt, 2000). Some authors have also suggested that psychological disorders secondary to ASDs may be a reaction to some of the social consequences and stressors of having a developmental disorder like an ASD (Tantam,

2000). In addition, some research suggests that environment plays a role in the manifestation of psychiatric disorders, such as elevated anxiety and stress levels in the parents, lack of social support, and inadequate communication and coordination among social service providers (Mazzone, Ruta, & Reale, 2012).

Based on information about ASDs and comorbidity, children with ASD appear to be at higher risk for a variety of psychiatric conditions compared to typically developing children. The first systematic, epidemiological, community-based study of comorbidity in children with ASD found that 70% of children between 10 and 14 years old had at least one comorbid psychiatric disorder, and 41% had 2 or more (Simonoff, Pickles Charman, Chandler, Loucas, & Baird, 2008). In this study, the most common comorbid diagnoses were social anxiety disorder (29%), ADHD (28%), and oppositional defiant disorder (28%). In addition, 84% of the children with comorbid ADHD also received a diagnosis of a separate comorbid disorder (Simonoff, Pickles Charman, Chandler, Loucas, & Baird, 2008).

Autism Spectrum Disorders and “Optimal Outcomes”

There is considerable evidence that, generally, social and pragmatic language symptoms of ASDs persist into adolescence and adulthood. However, some research studies have noted the phenomenon of “recovery,” in which individuals lose their ASD diagnosis. The first published study noting “recovery” in autism was conducted by Lovaas (1987). He reported that after receiving intensive behavioral intervention, nine of 19 children in the study “recovered,” as indicated by completion of first grade in a regular classroom and by achieving an average or above IQ score. However, this study did not indicate whether autism symptomatology had been completely resolved. Since then, studies have found somewhat lower rates of “recovery,” generally between 3% and 25%, using varied criteria (see Helt et al., 2008 for a review).

Therefore, stricter criteria have been proposed to define recovery or “optimal outcome” (OO). Specifically, the proposed definition of OO requires that the individual has a well-documented history of ASD, no longer meets criteria for any ASD, and that both IQ and adaptive functioning scores are within the average range (Helt et al., 2008).

A few recent studies have examined in greater depth the current behavioral presentation of children who have achieved OO. Given the high rates of psychiatric comorbidity in ASD, one may expect that the symptoms of the comorbid disorder(s) may continue even after the symptoms of ASD abate. Results of some studies have indeed found evidence for continuing psychiatric difficulties in children and adolescents who achieve OO. One study from our laboratory found that, in a small number of children, ASD in early childhood evolved into clear cases of Attention-Deficit/Hyperactivity Disorder (ADHD) by age eight (Fein, Dixon, Paul, & Levin, 2005). Five out of 11 OO children met criteria for ADHD-Inattentive Type, while six were diagnosed with ADHD-Combined Type. All of the children continued to display mild social awkwardness or delays, but their social difficulties were more consistent with those typically found in children with ADHD, rather than in children with ASD. Specifically, the children tended to act impulsive, aggressive, or immature, rather than withdrawn or odd (Fein et al., 2005). In a preliminary analysis using a subset of the sample used in the current study, Tyson (2010) found that 6 out of 28 (21%) of the OO children and adolescents met current criteria for ADHD, according to parent report. The prevalence of ADHD in children and adolescents who achieve OO may suggest that ASD and ADHD are comorbid, and when the symptoms of ASD remit, the symptoms of ADHD are still present. Alternatively, these findings may indicate that attentional features are part of ASD itself, but that attentional problems are more challenging to remediate than the core symptoms of ASD (Fein et al., 2005). Another

possibility is that the symptoms of ASD change over time and the later presentation looks more like that seen in ADHD. Tyson (2010) also found an elevated rate of specific phobia in the preliminary OO sample, with 4 out of 28 (14%) of the OO children and adolescents meeting current diagnostic criteria, suggesting some level of anxiety in these individuals. Of note, OO children and adolescents displayed phobias that are somewhat unusual compared to typical children, such as babies crying, crowds, and loud noises.

Another study on the current behavioral presentation of children who have achieved OO focused on language functioning in a group of 14 OO children, ages 5-9 (Kelley, Paul, Fein, & Naigles, 2006); the OO children in this study, although within the normal range on all standardized language measures, continued to experience subtle difficulties in semantic and pragmatic areas of language. The OO group's difficulty in pragmatic language occurred on tasks of understanding theory of mind, differentiating the meaning of mental state verbs (e.g., think, guess, and know) and producing verbal narratives to a storybook (e.g., providing incorrect and redundant information, minimal causal explanations, and limited mention of the goals and motivation of the story characters) (Kelley et al., 2006). A later study of OO children found that 13 OO children, ages 8-13, had language, adaptive, and problem behavior scores within the average range and no longer exhibited any behaviors indicative of ASD (Kelley, Naigles, & Fein, 2010). Unlike the previous study with younger children, there were no deficits in pragmatic language in these older OO children, suggesting that perhaps these language skills continued to improve with age. However, Kelley et al. (2010) utilized only standardized measures of pragmatic language, so subtle deficits may not have been detected. In a recent study using the current participant sample, Orinstein et al. (2010) examined communication and social functioning of OO children and adolescents between the ages of 8 and 21, using standardized

measures, including the Autism Diagnostic Observation Schedule (ADOS) and the Vineland Adaptive Behavior Scales. The results suggested that the OO individuals were performing very well in both the communication and social domains, with just some mild weaknesses in insight into the nature of typical social relationships and appropriateness of eye contact. The most recent study by Fein et al. (2013) on the same sample of OO children and adolescents found that the OO participants did not differ from the TD participants on summary measures of socialization, communication, face recognition, or most language subscales.

Current Study

The current study was designed to address a number of aims. The first aim was to examine the social and pragmatic behaviors of children and adolescents who have achieved optimal outcomes using an observational coding system designed to detect more mild difficulties. Given the elevated risk of psychiatric co-morbidities in individuals with ASDs, the second goal was to explore whether children and adolescents who have achieved optimal outcomes exhibit any social difficulties not specific to ASDs and that may be associated with psychiatric comorbidity, such as ADHD, depression, or anxiety. Importantly, the purpose was not to identify the rates of these co-morbidities, but rather to see if naïve raters judge features of these psychiatric disorders to be present and impacting perceived social functioning. Finally, the last aim was to determine whether children and adolescents who have achieved optimal outcomes are perceived as being as socially competent and as likable as their typical peers. It is hypothesized that the optimal outcome children and adolescents will exhibit some mild social and pragmatic difficulties, including those that are common in children with other psychiatric disorders. Furthermore, it was expected that at least some of the children and adolescents with

optimal outcomes would be rated as less socially competent and likable than age-matched, typically developing children and adolescents.

Methods

The current study used participants from the study by Fein et al. (2013). Participants included 24 children and adolescents with a history of ASDs who achieved optimal outcomes (OO), 29 high-functioning children and adolescents with a current ASD diagnosis (HFA), and 26 typically developing peers (TD). Participants ranged from 8 years, 5 months to 21 years, 2 months. The groups did not differ on age, gender, or nonverbal IQ, but were significantly different on verbal IQ (see Table 1). The participants were predominantly White, with 3 individuals in the OO group, 1 individual in the HFA, and 3 individuals in the TD group reporting other races or ethnicities.

Recruitment was done through media outlets (newspaper stories, radio interviews), private practices, and clinic referrals. In some cases, therapists contacted parents of children known to have optimal outcomes, and in some cases, parents saw media reports and contacted the investigators. Participants were also referred from the principal investigators' private practices, the Psychological Services Clinic at the University of Connecticut, and from other ongoing studies at the University of Connecticut. Finally, some participants in each group were informed about the study by other participants' families. The study was approved by Institutional Review Boards at the University of Connecticut, the Institute of Living of Hartford Hospital and Queens University.

Inclusion criteria. All participants had verbal, nonverbal, and full-scale IQ standard scores greater than 77 (within 1.5 SD of the average of 100). Additional OO criteria were:

- (1) Participants had an ASD diagnosis before the age of 5 by a physician or psychologist specializing in autism, in a written report. Documented early language delay (no words

by 18 months or no phrases by 24 months) was required. As a second step in confirming diagnosis, the report was edited to remove information about diagnosis, summary, and recommendations but leaving descriptions of behavior. One of the co-investigators (MB), an expert in diagnosis of ASD and Director of the University of Connecticut Psychological Services Clinic, reviewed these reports, blind to early diagnosis and current group membership. In addition to potential OO participants, she reviewed 24 "foil" reports for children with non-ASD diagnoses, such as global delay or language disorder. Four potential OO participants were rejected for insufficient early documentation, and were dropped from the study. All 24 foils were correctly rejected.

- (2) On the phone screening, parents had to report that the participant had typically developing friends. During evaluation, participants could not currently meet criteria for any ASD according to the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) administered by a research-reliable interviewer. The OO group was not matched to the TD group on ADOS scores, allowing for differences between the groups to be assessed. In addition, the ADOS videotapes of all potential OO cases was reviewed by a clinician with more than 15 years of autism diagnostic experience (IME, MB, or DF) who confirmed that ADOS scores were below ASD thresholds and that, in their expert clinical judgment, an ASD was not present. Five potential OO participants were judged to have social impairments with an autistic quality and were excluded (see Figure 1).
- (3) Participants' scores on the Communication and Socialization domains of the Vineland Adaptive Behavior Scales (Vineland; Sparrow, Balla, & Cicchetti, 1985) had to be greater than 77 (within 1.5SDs of the mean of 100). The OO group was not matched to

the TD group on Vineland scores, allowing for differences between the groups to be assessed.

- (4) Participants had to be fully included in regular education classrooms with no one-on-one assistance and no special education services to address autism deficits (e.g., no social skills training). However, participants could be receiving limited special education services or psychological support to address impairments not specific to ASDs, such as attention or academic difficulties.

To be included in the HFA group:

1. Following Collaborative Programs of Excellence in Autism diagnostic guidelines (Luyster et al., 2005), participants had to meet criteria for ASD on the ADOS (both Social and Communication domains and total score) and according to best estimate clinical judgment.

To be included in the TD group:

1. Participants could not meet criteria for any ASD at any point in their development, by parent report.
2. Participants could not have a first-degree relative with an ASD diagnosis.
3. Participants could not meet current diagnostic criteria for an ASD on the ADOS, or by clinical judgment. There was no attempt to exclude TD children for other learning or psychiatric disorders (but see general exclusion criteria).
4. Scores on the Communication and Socialization domains of the Vineland had to be greater than 77.

Exclusion criteria. Potential participants for any group were excluded if (1) at the time of the telephone screening they exhibited symptoms of major psychopathology (e.g., active

psychotic disorder) that would impede full participation, (2) they had severe visual or hearing impairments, or (3) they had a seizure disorder, Fragile X syndrome, or significant head trauma with loss of consciousness. Two in the TD group and two in the HFA group were excluded because of possible seizure disorder; none were excluded for other reasons.

Measures

Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was used to assess the verbal and nonverbal cognitive abilities of the participants.

Vineland Adaptive Behavior Scales (Vineland; Sparrow et al., 1985) assesses an individual's functioning in daily life through an interview with the primary caregiver. The Vineland was used to examine adaptive communication, socialization, and daily living skills across the three groups.

Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) is a structured play and interview session designed to encourage communication, social interaction and imaginative use of materials. Either Module 3 or 4 of the ADOS was used, depending on the age and developmental level of each participant. The participant's behavior was then coded on items in the domains of Communication, Reciprocal Social Interaction, Imagination/Creativity, and Stereotyped Behaviors and Restricted Interests. Scores for each item range from 0 to 3, with higher scores indicating more severe behaviors. ADOS administrations were videotaped and five administrations per group were coded by a rater blind to group status. Inter-rater reliability was coded based on the method determined by the test authors and was high for both the algorithm and total items, at 86.7% and 85.7%, respectively. Given the primarily interview and conversation format of Modules 3 and 4, the ADOS is considered to be an appropriate sample of social communicative skills.

Yale Adaptation of the Pragmatic Rating Scale (Y-PRS; Landa et al., 1992; Paul et al., 2009) assesses thirty different pragmatic behaviors that are often impaired in individuals with ASDs. The items are classified into three scales: Pragmatic Behaviors, which focus on topic management and reciprocity; Speech and Prosodic Behaviors, which focus on speech characteristics; and Paralinguistic Behaviors, which focus on physical behaviors which accompany speech. See Appendix A for a list of all items on the Y-PRS and below for rating procedures.

Semistructured Clinical Interview for Children & Adolescents (SCICA) Observation Form (McConaughy & Achenbach, 2001) allows for the rating of observations of participants' behavior, affect, and interaction style. The items on the observation form of the SCICA combine to produce syndrome scales, including: Anxious, Withdrawn/Depressed, Language/Motor Problems, Attention Problems, and Self-Control Problems. The domains were proposed by the authors of the test, based on factor analyses. The Language/Motor items seem more reflective of the child's Immaturity; therefore, the domain will be referred to as such in this paper. The participant's score on each scale can then be converted into a clinical *T*-score. The clinical *T*-scores and percentiles are derived from samples of 381 clinically-referred 6-11-year-old children and 305 clinically-referred 12-18-year-old children, not from normative samples of non-referred children. The sample was drawn from American and Dutch children who were referred for mental health services or special education services for behavioral, emotional, or learning problems (McConaughy & Achenbach, 2001). There are also items for other problematic behaviors on the SCICA that tend to be lower frequency and did not fall onto any of the syndrome scales when the scales were developed using factor analysis. These Other Behaviors are included in a Total Observation clinical *T*-score, along with all of the items on the syndrome

scales. Only select items were included in the coding for the current study. See Appendix B for a list of all items on the SCICA Observation Form used in the present study. Some items were excluded because they were unlikely to be elicited/observed in the context of the ADOS interview.

Reysen Likability Scale (Reysen, 2005) is used to assess a participant's likability, including factors such as knowledge and attractiveness, as well as requiring the rater to imagine the participant as part of their lives in roles such as friend, roommate, or coworker. The scale was modified for the present study to include three additional items, which asked the rater to judge the likelihood that the participant has a group of friends, has a best friend, and is popular.

Procedure

As part of the larger study, phone screenings were conducted with the parents of each participant as an initial assessment of exclusion and inclusion criteria. Those who passed were scheduled for an assessment. The evaluation was administered over the course of two or three testing sessions at the University of Connecticut, the Institute of Living of Hartford Hospital, Queens University, or in the participant's home. Testing was conducted in a quiet room with one examiner and lasted approximately six hours. In most cases, parent interviews were conducted concurrently by a second examiner and lasted approximately three hours for the OO and HFA groups and one-and-a-half hours for the TD group. At the end of each testing session, the participant received a monetary incentive for participation.

Y-PRS Coding. The procedure for completing the Y-PRS is based on that utilized by Paul, Orlovski, Marcinko, and Volkmar (2009). The first 30 minutes of the ADOS videos was analyzed to complete the Y-PRS. Each behavior on the Y-PRS is coded on a three point scale, with 0 being occurs almost never, 1 being occurs sometimes, and 2 being occurs almost always.

A trained undergraduate observer, blind to group status, watched ten consecutive, three-minute segments of each ADOS interview, coding all Y-PRS items after each segment. Eighteen percent of the videos were coded by two trained undergraduate observers, for reliability purposes. Despite extensive training and practice coding using participants who were excluded from the study after completion of the ADOS, acceptable inter-rater reliability was not obtained. Therefore, the data from this measure will not be utilized in this study.

SCICA Observation Form Coding. The first 30 minutes of the ADOS videos was again utilized to complete the SCICA Observation Form. Each behavior on the SCICA Observation Form is coded on a four point scale, with 0 being no occurrence, 1 being slight or ambiguous occurrence, 2 being definite occurrence with mild to moderate intensity, and 3 being definite occurrence with severe intensity. Behaviors were rated within five domains: Anxious, Withdrawn/Depressed, Immaturity, Attention Problems, and Self-Control Problems. A total score for each scale was calculated by summing the individual item scores within that scale. Clinical T scores were calculated for each participant for three of the five domains (Anxious, Withdrawn/Depressed, and Attention Problems) and compared with the clinical normative data published by the test's authors. A trained undergraduate observer, blind to group status, watched the ADOS interview, coding all SCICA Observation items one time, at the end of the 30 minutes. Eighteen percent of the videos were coded by two trained undergraduate observers, for reliability purposes. Intraclass correlations for the domain total scores ranged from .63 to .81, which is considered high moderate to good reliability (Doi & Williams, 2013).

Modified Reysen Likability Scale Coding. One five to seven minute segment of the ADOS videos was used to complete the modified Reysen Likability Scale. The video segment included the portions of the ADOS in which the participant talks about emotions and tells the

story of a cartoon. Five undergraduate research assistants watched the ADOS segments and coded the modified Reysen Likability Scale. Because this scale was being utilized to obtain an overall impression of each participant and because likability is based on individual preferences, inter-rater reliability was not calculated for this measure. Each question was scored using a Likert scale format, from 1 (very strongly disagree) to 7 (very strongly agree). The raters were told to rate the items as if they were the same age as the participant. All items are positively scored, with higher scores representing greater likability or social status of the participant. The scores for each participant were averaged across observers to create an average score for each item. A total score for modified Reysen Likability Scale was computed by summing the average scores for each item to create a total likability score for each participant.

Results

SCICA Observation Form

Anxious Scale

A MANOVA was conducted to determine whether there were group differences on the items that make up the Anxious scale of the SCICA. The MANOVA indicated no significant group differences on the combined dependent variables, $F(26, 100)=1.02$, $p=.449$, Wilks' $\lambda=.62$; partial eta squared=.21.

Withdrawn/Depressed Scale

Another MANOVA was conducted to determine whether there were group differences on the items that make up the Withdrawn/Depressed scale of the SCICA. The MANOVA indicated significant group differences on the combined dependent variables, $F(34, 106)=1.93$, $p=.006$, Wilks' $\lambda=.38$; partial eta squared=.38. Because the MANOVA showed group differences on the Withdrawn/Depressed scale of the SCICA, a one-way between-groups ANOVA was conducted

to explore the impact of group (OO, HFA, or TD) on the Withdrawn/Depressed total score, which was created by summing the individual items. There was a statistically significant difference between the groups on the Withdrawn/Depressed total score, $F(2, 73) = 10.09, p < .001$ (see Table 2), with the HFA group scoring higher than the OO and TD groups based on the Tukey HSD post-hoc test. In addition, because the objective of this study was to discover more subtle social difficulties in the OO group, non-conservative, exploratory independent sample t -tests were conducted to ascertain whether or not the OO and TD groups differed on the Withdrawn/Depressed score. As shown in Table 3, the OO group's score on the Withdrawn/Depressed scale was not different from the TD group.

When the results for the individual Withdrawn/Depressed dependent variables in the MANOVA were considered separately, 7 items differed by group. The items were: **avoids eye contact**, $F(2, 69)=9.03, p<.001$, partial eta squared = .21; **limited conversation**, $F(2, 69)=3.93, p=.024$, partial eta squared = .10; **limited fantasy or imagination**, $F(2, 69)=4.69, p=.012$, partial eta squared = .12; **reluctant to discuss feelings or personal issues**, $F(2, 69)=10.98, p<.001$, partial eta squared = .24; **says “don’t know” a lot**, $F(2, 69)=5.39, p=.007$, partial eta squared = .14; **slow to respond verbally**, $F(2, 69)=4.57, p=.014$, partial eta squared = .12; and **stares blankly**, $F(2, 69)=10.76, p<.001$, partial eta squared = .24. One-way between-groups ANOVAs conducted to determine which groups differed were significant for all seven items (see Table 4). Tukey HSD or Games Howell post-hoc tests (depending on homogeneity of variance for each item) showed that the HFA group scored significantly higher (worse) than the OO group on all items and significantly higher than the TD group on several items (avoids eye contact, reluctant to discuss feelings, and stares blankly). Using the same post-hoc tests, the OO group never scored significantly worse than the TD group but did score significantly better than the TD

group on one item (limited fantasy or imagination). Exploratory planned comparison *t*-tests for these seven items, which were conducted for the reason described above, showed that the OO group scored higher (worse) than the TD group on one item (stares blankly), with a medium effect size, and lower (better) than the TD group on one other item (limited fantasy or imagination), also with a medium effect size (see Table 5).

Immaturity Scale

A MANOVA was conducted to determine whether there were group differences on the items that form the Immaturity scale of the SCICA. The MANOVA indicated significant group differences on the combined dependent variables, $F(18, 128)=3.19, p<.001$, Wilks' $\lambda=.47$; partial eta squared=.31. Because the MANOVA showed group differences on the Immaturity scale of the SCICA, a one-way between-groups ANOVA was conducted to explore the impact of group on the Immaturity total score, which was created by summing the individual items. There was a statistically significant difference between the groups on the Immaturity total score, $F(2, 73) = 12.20, p < .001$ (see Table 2), with the HFA group scoring higher than the OO and TD groups based on the Games-Howell post-hoc test. In addition, an exploratory planned comparison *t*-test was conducted to determine whether the OO group differed from the TD group on the Immaturity total score, and showed that the OO group's mean score was significantly higher than the TD group, with a medium effect size (see Table 3).

When the results for the individual Immaturity dependent variables in the MANOVA were considered separately, 4 items differed by group. The items were: **giggles too much**, $F(2, 71)=4.81, p=.011$, partial eta squared = .12; **acts too young for age**, $F(2, 71)=14.89, p<.001$, partial eta squared = .30; **lapses in attention**, $F(2, 71)=4.13, p=.020$, partial eta squared = .10; and **needs repetition of instructions or questions**, $F(2, 71)=9.38, p<.001$, partial eta squared =

.21. One-way between-groups ANOVAs conducted to determine which groups differed for each of the seven items were all significant (see Table 6). Games Howell post-hoc tests showed that the HFA group scored significantly higher (worse) than the OO group on only one item (acts too young for age) and significantly higher than the TD group on several items (acts too young for age, lapses in attention, and needs repetition of instructions or questions). Using the same post-hoc tests, the OO group scored significantly worse than the TD group on one item (giggles too much). Exploratory planned comparison *t*-tests for these four items showed that the OO group scored higher (worse) than the TD group on giggles too much (large effect size) and acts too young for age (medium effect size) (see Table 7).

Attention Problems Scale

A MANOVA was conducted to determine whether there were group differences on the items that make up the Attention Problems scale of the SCICA. The MANOVA indicated significant group differences on the combined dependent variables, $F(18, 128)=2.19, p=.006$, Wilks' $\lambda=.59$; partial eta squared=.24. Because the MANOVA showed group differences on the Attention Problems scale of the SCICA, a one-way between-groups ANOVA was conducted to explore the impact of group on the Attention Problems total score, which was created by summing the individual items. There was a statistically significant difference between the groups on the Attention Problems total score, $F(2, 73) = 11.42, p < .001$ (see Table 2), with the HFA group scoring higher than the OO and TD groups based on the Games-Howell post-hoc test. In addition, a planned comparison *t*-test between the OO and TD group showed that OO group's total score on the Attention Problems scale was marginally higher the TD group, with a medium effect size (see Table 3).

When the results for the individual Attention Problems dependent variables in the MANOVA were considered separately, 7 items differed by group. The items were: **complains of tasks being too hard or upset by tasks**, $F(2, 72)=4.36$, $p=.016$, partial eta squared = .11; **does not concentrate or pay attention for long on tasks, questions, topics**, $F(2, 72)=6.28$, $p=.003$, partial eta squared = .15; **does not sit still, restless, or hyperactive**, $F(2, 72)=4.52$, $p=.014$, partial eta squared = .11; **easily distracted by external stimuli**, $F(2, 72)=5.35$, $p=.007$, partial eta squared = .13; **frequently off-task**, $F(2, 72)=5.23$, $p=.008$, partial eta squared = .13; **out of seat**, $F(2, 72)=3.27$, $p=.044$, partial eta squared = .083; and **wants to quit or does quit tasks**, $F(2, 72)=14.16$, $p<.001$, partial eta squared = .28. One-way between-groups ANOVAs conducted to determine which groups differed showed significant differences for all items except out of seat (see Table 8). Games Howell post-hoc tests showed that the HFA group scored significantly higher (worse) than the TD group on five of the six significant items and marginally higher than the OO group on only one item (complains of tasks being too hard). Using the same post-hoc tests, the OO group did not differ from the TD group on any items. Exploratory planned comparisons using t -tests for these seven items showed that the OO group scored higher (worse) than the TD group on easily distracted by external stimuli (medium effect size) and frequently off-task (medium effect size) (see Table 9).

Self-Control Problems Scale

Finally, a MANOVA was conducted to determine whether there were group differences on the items from the Self-Control Problems scale of the SCICA. The MANOVA indicated significant group differences on the combined dependent variables, $F(18, 124)=2.54$, $p=.001$, Wilks' $\lambda=.53$; partial eta squared=.27. Because the MANOVA showed group differences on the Self-Control Problems scale of the SCICA, a one-way between-groups ANOVA was conducted

to explore the impact of group on the Self-Control Problems total score, which was created by summing the individual items. There was a statistically significant difference between the groups on the Self-Control Problems total score, $F(2, 73) = 5.49, p = .006$ (see Table 2), with the HFA group scoring higher than the TD group based on the Tukey HSD post-hoc test. An exploratory planned comparison t -test indicated that the OO group's total score on the Self-Control Problems scale was significantly higher the TD group's score, with a medium effect size (see Table 3).

When the results for the individual Self-Control Problems dependent variables in the MANOVA were considered separately, 4 items differed by group. The items were: **defiant, talks back, or sarcastic**, $F(2, 70)=8.41, p=.001$, partial eta squared = .19; **impulsive or acts without thinking**, $F(2, 70)=3.51, p=.035$, partial eta squared = .09; **laughs inappropriately**, $F(2, 70)=4.02, p=.022$, partial eta squared = .10; and **strange behavior**, $F(2, 70)=4.50, p=.015$, partial eta squared = .11. One-way between-groups ANOVAs conducted to determine which groups differed were significant for all four items (see Table 10). Games Howell post-hoc tests showed that the HFA group scored significantly higher (worse) than the TD group on all four items and significantly higher than the OO group on two items (defiant and strange behavior). Using the same post-hoc tests, the OO group did not differ from the TD group on any items. Exploratory planned comparison t -tests for these four items showed that the OO group had more inappropriate laughter than the TD group, with a medium effect size (see Table 11).

Potentially Severe Problems

Because the normative data for the SCICA is from samples of clinically referred children ages 6-11 and 12-18, clinical T scores > 55 (> 69 th percentile) are considered to indicate potentially severe problems. Chi-square tests were conducted to determine whether the

frequency of potentially severe problems differed between groups. This was only conducted for the Anxious, Withdrawn/Depressed, and Attention Problems scales because not all items were coded in the other domains. The groups were not significantly different on the frequency of potentially severe problems on the Anxious domain, although there was a trend with a small to medium effect size, as 11% of HFA participants were above the cutoff compared with 0% in the other two groups (see Table 12). There was a significant difference between the groups on the frequency of participants with potentially severe problems in the Withdrawn/Depressed domain, with a medium to large effect size. Post-hoc tests revealed that significantly more participants in the HFA group (68%) had problems related to being withdrawn/depressed, compared with 24% in the OO group and 28% in the TD group (see Table 12). There was also a significant difference between the groups on the frequency of participants with potentially severe problems in the Attention Problems domain, with a medium to large effect size. Post-hoc tests revealed that significantly more participants in the HFA group (43%) and OO group (17%) had attention problems, compared with 0% in the TD group (see Table 12).

Correlation Analyses

The Immaturity and Attention Problems scales of the SCICA were highly correlated with each other, for the entire sample and within each group, suggesting that these scales may be tapping into similar behaviors (see Table 13).

The Anxious scale was generally not associated with IQ, ADOS symptoms, or adaptive functioning. For the other scales, significant correlations were often found when looking at the entire sample, but these relationships were less powerful or absent within the separate groups. Correlations for the entire sample are discussed below; the reader is referred to Table 13 to see the correlation matrices for the individual groups. For the entire sample, the

Withdrawn/Depressed scale was positively correlated with ADOS scores (more depression symptoms related to more autism communication/social symptoms) and negatively with correlated with adaptive functioning (more depression symptoms related to poorer communication and social adaptive functioning). The Immaturity and Attention Problems scales were positively correlated with ADOS communication and social scores and negatively correlated with adaptive social scores. The Self-Control Problems scale was positively correlated with ADOS communication and Social scores.

Modified Reysen Likability Scale

A repeated measures ANOVA was conducted to compare the average Likability score for each rater (raters 1-5) for each group (HFA, OO, TD). There was a significant mean effect of rater, Wilks' Lambda = .476, $F(4, 36) = 9.91$, $p < .001$ (see Figure 1). However, more importantly, there was no rater by group interaction, Wilks' Lambda = .719, $F(8, 72) = 1.62$, $p = .136$ (see Figure 1). Therefore, the raters' scores were averaged together for the group analyses.

All of the items on the Modified Reysen Likability Scale were highly correlated with each other (r s between .40 and .91), suggesting that all items are likely tapping into different aspects of the same construct. The current analyses looked at the 14 individual items on the Modified Reysen Likability Scale (Table 14). A MANOVA indicated a significant group difference on the combined dependent variables, $F(28, 118) = 3.04$, $p < .001$, Wilks' $\lambda = .34$; $d = 0.32$. An ANOVA of the Total score indicated that the OO (Mean=64.04, SD=7.19) and TD (Mean=62.10, SD=7.60) groups scored significantly higher than the HFA (Mean=51.29, SD=7.19) group, and did not differ from each other, $F(2, 72) = 23.60$, $p < .001$.

When the results for the dependent variables in the MANOVA were considered separately, all 14 variables differed by group. Thus, all items were probed using ANOVAs and post-hoc tests to determine which groups differed. All fourteen ANOVAs showed significant group differences. Results indicated that there were no items on which the OO group scored lower (worse) than the TD group, suggesting that OO participants were at least as likable as the TD participants (see Table 14). In fact, the OO group was rated as friendlier, warmer, and more approachable than the TD group. The HFA group scored significantly lower (worse) than the OO group on all 14 likability items and significantly worse than the TD group on 13/14 likability items (friendly was the only exception) (see Table 14). Exploratory planned comparison *t*-tests supported the results of the ANOVAs, with no additional differences between the OO and TD groups (see Table 15).

Given the wide age range of the participants, results were also examined separately for 8 to 12 year olds and for 13 to 18 year olds (see Tables 16 and 17). Similar results were found across both subset age groups, although with fewer significant items, particularly in the 8-12 age groups, presumably because of the smaller sample size. To further assess for differences in ratings based on participant age, correlations between the total score on the Modified Reysen Likability Scale and participant age were conducted. The Modified Reysen Likability Scale Total score was not correlated with age, for the entire sample ($r = .018, p = .882$), or within any individual group (OO group: $r = -.015, p = .946$, HFA group $r = .001, p = .996$, TD group $r = -.041, p = .849$) (see Table 18).

When examining the entire sample, the Modified Reysen Likability Scale Total score was negatively correlated with ADOS communication and ADOS socialization scores, which suggests that the *more* symptoms of autism in the communication and social domains, the *less*

likable the child was rated (see Table 18). In addition, the Modified Reysen Likability Scale Total score was positively correlated with Vineland socialization scores and Verbal IQ, indicating that better adaptive social skills or stronger verbal skills were associated with a higher rating of likability (see Table 18). When examining correlations just for the OO group, the only relationship found was a negative correlation between the Modified Reysen Likability Scale Total score and both ADOS communication and socialization (see Table 18). For the HFA group, the Modified Reysen Likability Scale Total score was only negatively correlated with the ADOS communication score. Finally, for the TD group, the Modified Reysen Likability Scale Total score was not significantly correlated with any other measure, although correlations showed the same general pattern as the entire sample.

Relationship between Measures

When the entire sample was examined, the Likability total score was significantly negatively correlated with the SCICA total, Withdrawn/Depressed scale, Immaturity scale, and Attention Problems scale (see Table 19). The pattern was the same for the individual groups, with less significant correlations, as some of the relationships had a somewhat smaller magnitude within groups. The only exception was that there was no relationship between the Likability Total and Attention Problems for the TD group.

Discussion

Summary of results:

1. Anxiety: There were no group differences on the Anxious scale items or on the frequency of participants with potentially severe anxiety problems.
2. Withdrawal/Depression: The HFA group had higher (worse) Withdrawn/Depressed scores than the OO group and the OO group did not differ from the TD group. The OO

group scored worse than TD group on one item (stares blankly) and better than the TD on one other item (limited fantasy or imagination); the other five items did not differ. More participants in the HFA group had potentially severe problems related to being withdrawn/depressed, compared with the OO and TD groups.

3. Immaturity: The HFA group had higher (worse) Immaturity scores than the OO group and the OO group had higher scores than the TD group. The OO group scored worse than the TD group on two out of the four examined items from this scale: giggles too much and lapses in attention.
4. Attention Problems: The HFA group had higher (worse) Attention Problems scores than the OO group and the OO group had marginally higher scores than the TD group. For two of the seven individual items examined on this scale, the OO group scored worse than the TD group. These items were easily distracted by external stimuli and frequently off-task. More participants in the HFA and OO groups had potentially severe problems related to attention, compared with the TD group.
5. Self-Control Problems: The OO group had higher (worse) Self-Control Problems than the TD group and did not differ from the HFA group. The OO group scored worse than the TD group on one out of the four examined items from this scale: laughs inappropriately.
6. More symptoms of depression, immaturity, attention problems, and self-control problems were positively related to more autism communication and social symptoms. More symptoms of depression, immaturity, and attention problems were related to poorer adaptive communication and/or social functioning.

7. Participants in the OO group were judged to be at least as likable as participants in the TD group. Participants in the HFA group were judged to be less likable than participants in the OO and TD groups.
8. The *more* communication and social symptoms of autism the participant had, the *less* likable the child was rated. Better adaptive social skills and higher verbal IQ were correlated with greater likability.
9. In general, more symptoms of withdrawal/depression, immaturity problems, and attention problems were correlated with lower ratings of likability.

Despite previous research showing high rates of anxiety disorders in children and adolescents with ASDs (de Bruin, Ferdinand, Meester, de Nijs, & Verheij, 2007; Gjevik et al., 2011; Joshi et al., 2010; Kim, Szatmari, Bryson, Streiner, & Wilson, 2000; Mattila et al., 2010; Muris et al., 1998; Simonoff et al., 2008), few symptoms of anxiety were found in any of the groups based on behavioral ratings in the current sample. However, given that anxiety disorders are internalizing disorders, it is possible that the ASD groups may have had higher rates of feelings of anxiety, which could have been found based on interview or self-report measures. Nonetheless, the goal of the current study was to determine if observable symptoms of anxiety impacted the social functioning of the OO participants. Since no differences were found in regards to behaviorally observable symptoms of anxiety (e.g., appearing nervous, preoccupation with certain thoughts, making self-deprecating remarks, easily embarrassed, etc.), it is unlikely that an anxious presentation could be significantly affecting the social interactions for the participants in the study.

Difficulties with depression and withdrawal were very high in the HFA participants in the current study, with 68% having potentially severe problems in this domain. This elevation is

significantly higher even than studies that have found increased prevalence of depression in ASD (Kim et al., 2000). However, this was based on behavioral presentation, rather than reporting of internal feelings of depressed mood/sadness, which is vital for a depression diagnosis. In fact, the behavioral symptoms of depression/withdrawal which were more prevalent in the HFA group were generally those that overlap with the symptoms of ASD, such as avoiding eye contact, stares blankly, limited conversation skills, limited fantasy or imagination, and reluctance to discuss feelings. Thus, the SCICA Withdrawn/Depressed scale cannot differentiate etiology of symptoms and the results were confounded with the behavioral presentation of ASD.

Importantly, however, the OO group did not display an increase in these symptoms, regardless of whether the etiology is from ASD itself or depression/withdrawal. As a result, withdrawal does not appear to be negatively impacting the social relatedness of the OO participants.

Ratings on the Immaturity scale of the SCICA suggest that the participants in both the OO and HFA groups, on average, presented as more socially immature than participants in the TD group. Specifically, OO and HFA participants acted too young for their age and giggled too much. Giggling too much was the only behavior which the OO group displayed more often/intensely than the HFA group. Similarly, on the Self-Control Problems scale, the OO and HFA participants were more likely to laugh inappropriately. The OO and HFA groups both had greater prevalence of participants with potentially severe attention problems than in the TD group. Specifically, on the Attention Problems scale, the OO and HFA participants were more likely to be easily distracted by external stimuli and frequently off-task than the TD participants, indicating a greater difficulty sustaining attention appropriately. In addition, the HFA participants were more likely than the OO participants to complain of tasks being too hard and wanting to quit tasks. The lack of these difficulties in the OO group suggest that they may not

avoid, dislike, or be reluctant to do tasks that require mental effort. The negative correlations between the Immaturity, Self-Control Problems, and Attention Problems scales and ADOS social scores indicate that more symptoms in these areas are related to poorer social functioning. Furthermore, the negative correlation between Immaturity and Attention Problems and the Likability total score provides more evidence that these difficulties are negatively impacting perceptions of social competence.

For the items on which the OO participants differed on the SCICA Immaturity, Attention Problems, and Self-Control Problems domains, the OO group's score was generally in between the scores of the HFA and TD groups, with roughly medium effect sizes separating the OO group from the HFA group and the OO group from the TD group. The current paper is based on the premise that HFA, OO, and TD are discrete groups and that the OO individuals have moved from one category (HFA) to another (OO). However, it is possible that these diagnoses reflect not distinct categories but rather a continuous distribution of traits from abnormal to normal. If so, it is possible that the OO individuals simply moved along the continuum to the point where they were indistinguishable on most dimensions from TD controls. We considered the possibility that the OO individuals fall in the middle of such a continuum from HFA to TD. However, the data from the study does not provide support for such a model as the OO group was largely indistinguishable from the TD group on the likability measure but displayed some differences on the SCICA Immaturity, Attention Problems, and Self-Control Problems domains. Either way, the OO group is not homogeneous; in fact, there is considerable variability in social functioning. Furthermore, the individuals in the OO group may have reached their current levels of functioning employing different compensation or normalization mechanisms or following different developmental trajectories; the current study cannot address these possibilities.

The likability data suggest that the OO participants were at least as likable as the TD participants when judged by a rater based on a brief video clip. It is noteworthy that, not only were there no differences in likability between the OO and TD participants, but the scores of the OO participants were extremely similar to those of the TD participants. In fact, OO participants were rated as friendlier, warmer, and more approachable than the TD participants, all of which have a large effect size, suggesting that this difference is meaningful and real. Extensive experience with therapists in the OO group may have contributed to this finding, as elements of social interactions may have been targeted behaviors. In addition, their history of intervention may have offered them relatively greater familiarity and comfort with adults. Ratings of interactions with peers would be needed to see if these likeability ratings would generalize to peer interactions. The HFA group, in general, was rated as less likable than the OO and TD participants, suggesting that their ASD symptoms interfere with their perceived social functioning and competence.

The results of the current study, taken together, suggest that the OO group might be exhibiting mild social difficulties which are more consistent with those seen in ADHD than in ASD. Children and adolescents with ADHD engage in less sharing, cooperation, or turn-taking (Barkley, 2006; Sibley, Evans, & Serpell, 2010; Wehmeier, Schacht, & Barkley, 2010). These difficulties were not seen in the OO children and adolescents in the current study, which may be due to the fact that they have received extensive early intervention in which they were explicitly taught and practiced these types of social skills. Consistent with the current findings in the OO group, previous studies have demonstrated that children and adolescents with ADHD are more frequently off-task (Barkley, 2006; Sibley et al., 2010; Wehmeier et al., 2010). In addition, they often interact with their peers in an awkward, self-centered, impulsive, and intrusive way

(Barkley, 2006; Sibley et al., 2010; Wehmeier et al., 2010). Furthermore, both inattention and hyperactivity/impulsivity can impair verbal and nonverbal elements of social communication, such as staying on topic and physical proximity (Staikova, Gomes, Tartter, McCabe, & Halperin, 2013). Children and adolescents with ADHD tend to have social communication problems related to difficulties responding appropriately to constantly changing demands of complex social situations (Landau & Moore, 1991). The OO participants in the current study were more likely to behave in a socially inappropriate, immature, or off-task manner, which is fairly similar to the difficulties described in previous studies for children and adolescents with ADHD. These results, along with the studies by Fein et al. (2005) and Tyson (2010) that found high incidence of ADHD symptomatology in OO children, provide evidence for the proposition that, at least in some cases, ASD early in life resolves into ADHD in later childhood and adolescence; even in children and adolescents who would not meet criteria for ADHD, some features of this cognitive and social style may be present. The attentional impairments of ASD may endure even after a child loses the ASD diagnosis. Attentional symptoms are typically part of the ASD behavioral presentation, though not included in the diagnostic criteria, and may potentially be more difficult to extinguish through intervention. These attention findings would be consistent with the suggestion that ADHD and ASD share common genetic pathways (Frazier et al., 2011; Ronald, Simonoff, Kuntsi, Asherson, & Plomin, 2008; Sinzig, Walter, & Doepfner, 2009). Tracking children with ASD longitudinally to discern how their attentional symptoms change over time might shed light on the trajectory of ADHD symptoms in children with ASD who achieve optimal outcomes.

There are several theories that have been postulated to account for the social and pragmatic difficulties found in ASDs. Social and pragmatic deficits in ASD have sometimes

been attributed to deficits in Theory of Mind or early empathy (the ability to infer the mental state of someone else) (Baron-Cohen, Leslie, & Frith, 1985) or executive function (McEvoy, Rogers, & Pennington, 1993; Ozonoff & McEvoy, 1994). The idea behind the latter theory is that social interactions and relationships require significant executive control in order to perform them effectively and efficiently. Although the current study cannot strongly differentiate between these theories, the results may provide support for the Executive Function Theory, in that even the OO participants, who have greatly improved social skills, still display some mild difficulties in areas consistent with weaker executive processes. It is possible that, despite other improvements, the prefrontal cortex does not develop as quickly or as completely in the OO adolescents. In fact, a previous study on the same sample found that, although still within the average range, on direct assessment, the OO and HFA groups displayed more impulsivity and less efficient planning and problem solving than the TD group (Troyb et al., 2013). On a parent report measure, the HFA participants were impaired on all domains, and the OO participants had lower attention shifting and working memory abilities than the TD participants. These results suggest that executive function abilities of the OO participants were not as well developed as might be expected given their above-average intellectual abilities (Troyb et al., 2013). The relative executive function weaknesses of the OO participants are consistent with a large body of literature showing that high-functioning adolescents and adults with ASDs have impaired performance on tasks that involve set-shifting, working memory, planning, and fluency (see Eigsti, 2011 for a review). The current study cannot speak directly to the executive function theory since correlations were not examined between executive function and the social abilities. Future research should examine the link between social abilities and executive functioning in OO

children and adolescents, ideally prospectively over time, as this may help elucidate the mechanisms and pathways underlying the core social and pragmatic difficulties in ASDs.

Limitations and Future Directions

The participants in the present study were predominantly White, with less than 10% belonging to other racial or ethnic groups. All three groups were high functioning, with mean nonverbal IQs in the high average range. Thus, these findings may not generalize well to other racial or ethnic groups, or to a broader spectrum of intellectual functioning. Future studies should include a more diverse sample.

A wide age range of participants was included in the current study. This approach was necessary in order to obtain a large enough sample of OO participants. However, the age range of 8 to 21 years spans developmental levels, with different communication and social demands. Thus, including such a large age range may have prevented finding differences at specific developmental levels. However, analyses showed no differences between younger and older subsamples or correlations with age, suggesting that age differences may not be overly impactful. Nonetheless, future studies may wish to examine social functioning in optimal outcome children at different age periods, in order to ascertain whether there is a developmental progression in the improvement in social functioning.

A significant limitation of the study is that initial ASD diagnosis was assessed retrospectively. Care was taken to obtain documentation of ASD symptoms in early diagnostic reports. Additionally, as reported by Fein et al. (2013), when parents were interviewed at the time of the present study, parents of the OO participants, compared with parents of HFA participants, reported histories of social symptoms that were somewhat milder on average. There was no difference between the two groups in early communication or repetitive behaviors (Fein

et al., 2013). While the combination of early diagnostic reports and parental recall enhance confidence in early presentation of ASD, the cross-sectional nature of the study does not address *how* communication and social skills change over time. Specifically, the current study could not fully assess how intervention played a role in improvement. Intervention data from this sample did show that the OO group, on average, had earlier and more intensive early intervention (Orinstein et al., in press); however, careful specification of the relationship of intervention to social outcome will require large scale prospective, longitudinal study.

A more integral limitation is the situation on which the coding was based. The ADOS was conducted in a one-on-one setting with minimal distractions by adult examiners experienced in working with children and adolescents with autism. The participants may have performed differently in a more natural environment or with naïve adults or peers. The participants were also aware that the ADOS administration was being videotaped, which could have affected their performance. Furthermore, the examiner was not naïve to group membership when administering the ADOS. Given the considerable difficulty individuals with HFA have with friendship (Howlin et al., 2000; Orsmond et al., 2004), close examination of peer interaction is warranted. Friendships occur in less quantity and with poorer quality for adolescents and young adults with autism, including even the most high functioning (DeMyer et al., 1973; Howlin, 2003; Howlin et al., 2000; Orsmond et al., 2004; Seltzer et al., 2003; Shattuck et al., 2007; Whitehouse et al., 2009). Friendships for individuals with ASD may differ from typically developing peers by how long they last, activities involved, and the frequency of get-togethers (Bauminger & Shulman, 2003; Bauminger, Solomon, Aviezer, Heung, Gazit, et al., 2008). Additionally, individuals with ASDs tend to have friends with disabilities more frequently than do typically developing peers (Bauminger & Shulman, 2003; Bauminger, Solomon, Aviezer,

Heung, Brown, et al., 2008; Bauminger, Solomon, Aviezer, Heung, Gazit, et al., 2008).

Friendships for individuals with ASD often are characterized by less companionship, security and help (Bauminger & Kasari, 2000). Observations of friendship dyads including individuals with ASD have noted less goal-directed behaviors, sharing and positive affect (Bauminger, Solomon, Aviezer, Heung, Gazit, et al., 2008) than dyads of typically developing peers.

Additionally, mothers of adolescents with ASD commonly report that considerable support is necessary in order for their children with high functioning autism to develop and maintain friendships (Bauminger & Shulman, 2003). In particular, assessment of friendship quantity and quality in the OO group should be conducted in order to determine if there are any peer-related social deficits that cannot be identifying based on interactions with an adult. Therefore, observation of friendship dyads would be ideal, in addition to parent report and self-report. Until we have a better and more thorough understanding of how the OO group performs in typical social relationships, we cannot rule out that they are experiencing some finer level of social impairment.

An additional limitation relates to the characteristics of the raters. All of the raters were undergraduate students at the University of Connecticut with an interest in psychology broadly and autism spectrum disorders more specifically. This raises opposing issues for the measures utilized in this study. For the likability ratings, the five undergraduate coders were about six years older, on average, than the participants in the study. While the goal was to get ratings by peers, using undergraduate research assistants was the best option given IRB restrictions related to protection of participants' privacy. In addition, the undergraduate students were educated in and aware of the difficulties associated with autism spectrum disorders. Even though they were blind to the purpose of the study and to group membership, it is possible that their ratings were

biased by their own knowledge. Future studies should include naïve age-matched peer ratings of likability if possible. For the SCICA, the measure was designed to be utilized by clinicians with specific training in mental health disorders. It is possible that the lack of clinical training by the undergraduate raters may have impacted their ability to accurately rate the items. However, the raters were closely trained by the author, an advanced doctoral student in clinical psychology, and the raters were able to obtain reasonably high reliability. Therefore, considerable confidence can be placed in the results for this measure. Nonetheless, it would be interesting to have the results replicated by raters with specific clinical training. Related to this, the inability to obtain sufficient reliability on the Yale Pragmatic Rating Scale may be due, at least in part, to the raters' less fine-tuned knowledge of autism spectrum disorders. The items on this measure seem to require a very high level of understanding of pragmatic behaviors and the subtle or not so subtle ways they may present in autism spectrum disorders. The authors of the Yale Pragmatic Rating Scale (Paul et al., 2009) seemed to have difficulty obtaining reliability themselves, as they only used a point-to-point inter-rater agreement on an average score on this measure. Thus, the Yale Pragmatic Rating Scale may not be useful for most research studies, unless completed by raters with significant clinical experience with autism spectrum disorders.

Conclusion

The OO participants in this study had some symptoms related to attention, self-control, and immaturity that may have impacted their social abilities. However, despite these subtle differences from the TD group in these domains, the OO group was judged to be as likable as the TD participants. This suggests that, at least while interacting with a trained adult, the OO participants have sufficient social skills to be judged likeable by peers. The HFA group, on the other hand, was judged to be less likable, probably due to the ASD symptoms and the significant

problems they demonstrated in terms of depression, attention, self-control, and immaturity areas. As a result, the HFA group had negatively viewed social abilities. In sum, the OO group is exhibiting mild social difficulties which are more consistent with those seen in ADHD than in ASDs, which may speak to the underlying etiology of social difficulties, at least in children who achieve optimal outcomes.

Figure 1. Average Likability Score by Rater

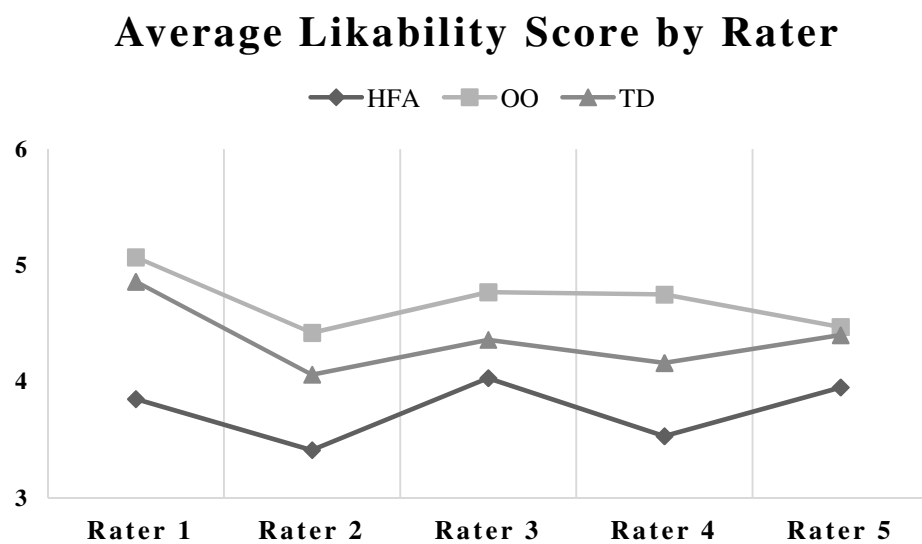


Table 1 Participant Characteristics

Mean (SD) Range	HFA (N=29)	OO (N=24)	TD (N=26)	F/χ^2	p	Post-hoc
Gender	27 M; 1 F	17 M; 6 F	22 M; 3 F	5.65	.059	
Age	13.1 (2.5) 8.63-18.45	13.5 (3.6) 8.47-21.24	13.6 (1.8) 9.93-17.4	0.27	.76	
VIQ	103.9 (12.6) 81-133	111.1 (14.3) 80-136	111.6 (11.6) 93-136	3.16	.048	Trend HFA < TD
NVIQ	110.7 (14.0) 78-147	112.6 (14.7) 87-142	113.5 (12.6) 89-139	0.29	.75	
Vineland— Communication	85.5 (11.7) 51-108	98.7 (12.4) 79-122	93.1 (7.4) 81-115	10.07	<.001	HFA<OO, TD
Vineland—Social	76.8 (15.2) 54-109	102.7 (8.8) 80-118	102.4 (8.1) 86-119	46.20	<.001	HFA<OO, TD
ADOS— Communication	3.45 (1.38) 2-7	0.42 (0.65) 0-2	0.50 (0.58) 0-2	87.15	<.001	HFA>OO, TD
ADOS— Social	6.72 (2.23) 4-13	0.92 (1.21) 0-3	0.58 (0.81) 0-2	131.76	<.001	HFA>OO, TD

Note: M=males, F=females; VIQ=Verbal IQ from the Wechsler Abbreviated Achievement

Scales (WASI); NVIQ=Nonverbal IQ from the WASI

Table 2: SCICA Observation Form

Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=25)	<i>F</i>	<i>p</i>	Post-hoc
Withdrawn/Depressed	12.14 (7.16)	4.04 (4.59)	6.76 (7.45)	10.09	<.001	HFA > OO, TD
Immaturity	4.57 (3.14)	2.50 (2.50)	1.26 (1.32)	12.20	<.001	HFA > OO, TD
Attention Problems	6.52 (5.01)	3.26 (4.15)	1.40 (1.88)	11.42	<.001	HFA > OO, TD
Self-Control Problems	4.16 (3.51)	3.15 (1.75)	1.62 (2.67)	5.49	.006	HFA > TD

Table 3: SCICA Observation Form—OO vs. TD *t*-tests

	OO (N=23)	TD (N=25)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Withdrawn/Depressed	4.04 (4.59)	6.76 (7.45)	1.51	.139	0.44
Immaturity	2.50 (2.50)	1.26 (1.32)	2.12	.035	0.62
Attention Problems	3.26 (4.15)	1.40 (1.88)	1.97	.058	0.58
Self-Control Problems	3.15 (1.75)	1.62 (2.67)	2.33	.024	0.68

Table 4: SCICA Withdrawn/Depressed

	Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=25)	<i>F</i>	<i>p</i>	Post-hoc
Avoids Eye Contact		1.66 (1.07)	0.65 (0.78)	0.78 (0.95)	8.82	<.001	HFA > OO, TD
Limited Conversation		1.39 (1.14)	0.48 (0.79)	0.92 (1.09)	5.02	.009	HFA > OO
Limited Fantasy or Imagination		0.91 (1.05)	0.09 (0.42)	0.60 (0.87)	6.08	.004	HFA, TD > OO
Reluctant to Discuss Feelings or Personal Issues		1.29 (1.19)	0.28 (0.75)	0.28 (0.58)	11.10	<.001	HFA > OO, TD
Says “Don’t Know” a Lot		1.02 (1.00)	0.33 (0.56)	0.48 (0.78)	5.22	.008	HFA > OO
Slow to Respond Verbally		0.91 (1.16)	0.13 (0.46)	0.36 (0.67)	5.93	.004	HFA > OO
Stares Blankly		1.39 (1.16)	0.67 (0.91)	0.22 (0.41)	11.62	<.001	HFA > OO, TD

Table 5: SCICA Withdrawn/Depressed—OO vs. TD *t*-tests

	OO (N=23)	TD (N=25)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Avoids Eye Contact	0.65 (0.78)	0.78 (0.95)	0.51	.613	-0.15
Limited Conversation	0.48 (0.79)	0.92 (1.09)	1.60	.117	-0.46
Limited Fantasy or Imagination	0.09 (0.42)	0.60 (0.87)	2.65	.012	-0.75
Reluctant to Discuss Feelings or Personal Issues	0.28 (0.75)	0.28 (0.58)	0.01	.989	0.00
Says “Don’t Know” a Lot	0.33 (0.56)	0.48 (0.78)	0.78	.440	-0.22
Slow to Respond Verbally	0.13 (0.46)	0.36 (0.67)	1.40	.170	-0.40
Stares Blankly	0.67 (0.91)	0.22 (0.41)	2.07	.048	0.64

Table 6: SCICA Immaturity

	Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=25)	<i>F</i>	<i>p</i>	Post-hoc
Giggles Too Much		0.34 (0.69)	0.70 (0.93)	0.14 (0.34)	3.98	.023	OO > TD
Acts Too Young for Age		1.13 (1.12)	0.30 (0.56)	0.02 (0.10)	15.67	<.001	HFA > OO, TD
Lapses in Attention		0.61 (0.82)	0.35 (0.78)	0.06 (0.30)	4.30	.017	HFA > TD
Needs Repetition of Instructions or Questions		1.34 (0.82)	0.78 (0.95)	0.38 (0.62)	9.56	<.001	HFA > TD

Table 7: SCICA Immaturity—OO vs. TD *t*-tests

	OO (N=23)	TD (N=25)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Giggles Too Much	0.70 (0.93)	0.14 (0.34)	2.72	.011	0.80
Acts Too Young for Age	0.30 (0.56)	0.02 (0.10)	2.41	.024	0.70
Lapses in Attention	0.35 (0.78)	0.06 (0.30)	1.67	.106	0.49
Needs Repetition of Instructions or Questions	0.78 (0.95)	0.38 (0.62)	1.72	.093	0.50

Table 8: SCICA Attention Problems

	Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=25)	<i>F</i>	<i>p</i>	Post-hoc
Complains of Tasks Being Too Hard/Upset by Tasks		0.39 (0.88)	0.00 (0.00)	0.04 (0.20)	4.16	.019	Trend for HFA > OO
Does Not Concentrate or Pay Attention for Long		0.66 (0.75)	0.39 (0.84)	0.04 (0.20)	5.91	.004	HFA > TD
Does Not Sit Still, Restless, or Hyperactive		1.13 (1.18)	0.74 (1.05)	0.34 (0.64)	4.12	.020	HFA > TD
Easily Distracted by External Stimuli		0.75 (0.98)	0.44 (0.79)	0.06 (0.22)	5.66	.005	HFA > TD
Frequently Off-Task		0.61 (0.92)	0.30 (0.64)	0.02 (0.10)	5.23	.008	HFA > TD
Out of Seat		0.63 (1.02)	0.39 (0.94)	0.06 (0.30)	3.09	.051	N/A
Wants to Quit or Does Quit Tasks		0.91 (1.09)	0.00 (0.00)	0.04 (0.20)	15.52	<.001	HFA > OO, TD

Table 9: SCICA Attention Problems—OO vs. TD *t*-tests

	OO (N=23)	TD (N=25)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Complains of Tasks Being Too Hard/Upset by Tasks	0.00 (0.00)	0.04 (0.20)	0.96	.343	-0.28
Does Not Concentrate or Pay Attention for Long	0.39 (0.84)	0.04 (0.20)	1.96	.062	0.57
Does Not Sit Still, Restless, or Hyperactive	0.74 (1.05)	0.34 (0.64)	1.57	.125	0.46
Easily Distracted by External Stimuli	0.44 (0.79)	0.06 (0.22)	2.20	.037	0.66
Frequently Off-Task	0.30 (0.64)	0.02 (0.10)	2.12	.045	0.61
Out of Seat	0.39 (0.94)	0.06 (0.30)	1.62	.118	0.47
Wants to Quit or Does Quit Tasks	0.00 (0.00)	0.04 (0.20)	0.96	.343	-0.28

Table 10: SCICA Self-Control Problems

	Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=25)	<i>F</i>	<i>p</i>	Post-hoc
Defiant, Talks Back, or Sarcastic		0.56 (0.80)	0.04 (0.21)	0.04 (0.20)	8.84	<.001	HFA > OO, TD
Impulsive or Acts Without Thinking		0.45 (0.88)	0.17 (0.49)	0.02 (0.10)	3.46	.037	HFA > TD
Laughs Inappropriately		0.50 (0.87)	0.35 (0.65)	0.02 (0.10)	3.82	.027	HFA > TD
Strange Behavior		0.29 (0.66)	0.00 (0.00)	0.00 (0.00)	4.50	.014	HFA > OO, TD

Table 11: SCICA Self-Control Problems—OO vs. TD *t*-tests

	OO (N=23)	TD (N=25)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Defiant, Talks Back, or Sarcastic	0.04 (0.21)	0.04 (0.20)	0.06	.953	0.00
Impulsive or Acts Without Thinking	0.17 (0.49)	0.02 (0.10)	1.48	.153	0.42
Laughs Inappropriately	0.35 (0.65)	0.02 (0.10)	2.40	.025	0.71
Strange Behavior	0.00 (0.00)	0.00 (0.00)	N/A	N/A	N/A

Table 12: SCICA Clinical T-Scores

N (%)	HFA (N=28)	OO (N=23)	TD (N=25)	Chi- Square	<i>p</i> Value	Cramer's V	Post-Hoc
Anxious	3 (11%)	0 (0%)	0 (0%)	5.35	.069	.265	
Withdrawn/Depressed	19 (68%)	3 (24%)	7 (28%)	17.71	<.001	.483	HFA > OO, TD
Attention Problems	12 (43%)	4 (17%)	0 (0%)	14.86	.001	.442	HFA, OO > TD

Table 13 Correlation Matrices between SCICA Scales, IQ Scores, ADOS Scores, and Vineland Scores
Correlation Matrix for All Groups Combined

	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Anxious	.036	.270*	.110	-.046	-.006	-.034	.155	.194	-.006	-.168
Withdrawn/Depressed		.373**	.230*	-.107	-.305**	-.066	.451**	.510**	-.292*	-.417**
Immaturity			.717**	.511**	-.145	-.091	.529**	.592**	-.105	-.358**
Attention Problems				.455**	-.252*	.001	.480**	.529**	-.131	-.402**
Self-Control Problems					-.003	-.136	.327**	.312**	.052	-.092
Verbal IQ						.394**	-.433**	-.358**	.299**	.217
Performance IQ							-.178	-.108	.231*	-.029
ADOS Communication								.846**	-.413**	-.622**
ADOS Socialization									-.283*	-.607**
Vineland Communication										.541**

* $p < .05$, ** $p < .01$

Correlation Matrix for OO Group

	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Anxious	.403	.229	.071	-.024	-.092	.053	-.111	-.077	-.032	-.209
Withdrawn/Depressed		.559**	.420*	-.280	-.379	-.102	.143	.292	-.385	-.398
Immaturity			.662**	.228	-.123	-.320	-.069	.275	-.139	-.065
Attention Problems				.175	-.207	-.183	.238	.378	-.078	-.407
Self-Control Problems					.408	-.019	-.196	.130	.189	.427*
Verbal IQ						.544**	-.385	-.337	.182	.266
Performance IQ							-.126	-.127	.207	-.015
ADOS Communication								.529**	-.099	-.358
ADOS Socialization									-.103	-.380
Vineland Communication										.403

* $p < .05$, ** $p < .01$

Correlation Matrix for HFA Group

	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Anxious	-.092	.212	-.052	-.183	-.005	-.040	-.012	.089	.028	-.077
Withdrawn/Depressed		.177	.024	-.187	-.125	.026	.058	.334	-.030	-.057
Immaturity			.632**	.474*	.032	.148	.425*	.495**	.220	.004
Attention Problems				.428*	-.132	.270	.232	.289	.073	-.045
Self-Control Problems					-.021	-.051	.255	.105	.228	.245
Verbal IQ						.302	-.521**	-.253	.216	-.183
Performance IQ							-.187	.020	.309	-.194
ADOS Communication								.395*	-.139	.158
ADOS Socialization									.436*	.387*
Vineland Communication										.414*

* $p < .05$, ** $p < .01$

Correlation Matrix for TD Group

	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Anxious	-.250	.157	.366	.012	.372	-.039	.067	-.076	.400*	.054
Withdrawn/Depressed		.212	-.209	-.339	-.280	-.087	.488*	.371	.110	-.086
Immaturity			.447*	.549**	.074	-.114	.275	.301	.221	-.086
Attention Problems				.427*	-.087	-.095	.011	-.003	.423*	.192
Self-Control Problems					.079	-.283	.105	.035	.087	-.039
Verbal IQ						.302	-.257	-.358	.347	.229
Performance IQ							-.411**	-.316	.187	-.082
ADOS Communication								.496*	.151	-.160
ADOS Socialization									.125	-.156
Vineland Communication										.164

* $p < .05$, ** $p < .01$

Table 14. Modified Reysen Likability Scale—All Participants

	Mean (SD)	HFA (N=28)	OO (N=23)	TD (N=24)	<i>F</i>	<i>p</i>	Post-hoc
1 Friendly		4.56 (0.60)	5.22 (0.37)	4.81 (0.60)	9.00	<.001	HFA, TD < OO
2 Likeable		4.20 (0.63)	5.08 (0.55)	4.84 (0.64)	14.51	<.001	HFA < TD, OO
3 Warm		3.87 (0.68)	4.68 (0.40)	4.16 (0.73)	10.57	<.001	HFA < TD < OO
4 Approachable		4.08 (0.69)	5.00 (0.38)	4.57 (0.65)	15.16	<.001	HFA < TD < OO
5 Would ask for advice		3.27 (0.59)	4.44 (0.70)	4.24 (0.67)	24.26	<.001	HFA < TD, OO
6 Would work on a school project		3.27 (0.65)	4.49 (0.75)	4.47 (0.63)	28.35	<.001	HFA < TD, OO
7 Would like as a roommate		2.94 (0.59)	4.02 (0.80)	3.88 (0.65)	19.51	<.001	HFA < TD, OO
8 Would like to be friends		3.73 (0.51)	4.62 (0.57)	4.45 (0.59)	19.17	<.001	HFA < TD, OO
9 Physically attractive		3.44 (0.63)	4.10 (0.87)	4.21 (0.68)	8.66	<.001	HFA < TD, OO
10 Similar to me		3.15 (0.52)	4.10 (0.61)	4.13 (0.57)	25.73	<.001	HFA < TD, OO
11 Knowledgeable		4.03 (0.68)	4.67 (0.61)	4.64 (0.58)	8.65	<.001	HFA < TD, OO
12 Likely has a group of friends		4.02 (0.69)	4.91 (0.58)	4.90 (0.58)	17.92	<.001	HFA < TD, OO
13 Likely has a best friend		3.99 (0.69)	4.79 (0.46)	4.83 (0.62)	16.02	<.001	HFA < TD, OO
14 Likely to be popular		2.73 (0.73)	3.93 (0.80)	3.96 (0.80)	21.71	<.001	HFA < TD, OO
TOTAL		51.29 (7.19)	64.04 (7.19)	62.10 (7.60)	23.60	<.001	HFA < TD, OO

Table 15. Modified Reysen Likability Scale—All Participants—OO vs. TD *t*-tests

	OO (N=23)	TD (N=24)	<i>t</i>-tests: OO vs. TD		
	Mean (SD)	Mean (SD)	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
1 Friendly	5.22 (0.37)	4.81 (0.60)	2.81	.007	0.82
2 Likeable	5.08 (0.55)	4.84 (0.64)	1.40	.168	0.40
3 Warm	4.68 (0.40)	4.16 (0.73)	3.04	.004	0.88
4 Approachable	5.00 (0.38)	4.57 (0.65)	2.72	.010	0.81
5 Would ask for advice	4.44 (0.70)	4.24 (0.67)	0.97	.335	0.29
6 Would work on a school project	4.49 (0.75)	4.47 (0.63)	0.10	.919	0.03
7 Would like as a roommate	4.02 (0.80)	3.88 (0.65)	0.66	.512	0.19
8 Would like to be friends	4.62 (0.57)	4.45 (0.59)	1.00	.321	0.29
9 Physically attractive	4.10 (0.87)	4.21 (0.68)	-0.48	.635	0.14
10 Similar to me	4.10 (0.61)	4.13 (0.57)	-0.18	.859	0.05
11 Knowledgeable	4.67 (0.61)	4.64 (0.58)	0.13	.896	0.05
12 Likely has a group of friends	4.91 (0.58)	4.90 (0.58)	0.02	.985	0.02
13 Likely has a best friend	4.79 (0.46)	4.83 (0.62)	-0.28	.784	0.07
14 Likely to be popular	3.93 (0.80)	3.96 (0.80)	-0.11	.913	0.04
TOTAL	64.04 (7.19)	62.10 (7.60)	0.90	.375	0.26

Table 16 Modified Reysen Likability Scale—8 to 12 year olds

	HFA (N=12)	OO (N=10)	TD (N=9)	<i>F</i>	<i>p</i>	Post-hoc
1 Friendly	4.64 (0.64)	5.19 (0.41)	4.82 (0.64)	2.52	.099	
2 Likeable	4.23 (0.77)	5.11 (0.65)	4.73 (0.64)	4.40	.022	HFA < OO
3 Warm	3.83 (0.62)	4.57 (0.43)	4.07 (0.79)	3.94	.031	HFA < OO
4 Approachable	4.13 (0.79)	4.95 (0.43)	4.47 (0.67)	4.19	.026	HFA < OO
5 Would ask for advice	3.49 (0.71)	4.51 (0.66)	4.24 (0.70)	6.56	.005	HFA < TD, OO
6 Would work on a school project	3.41 (0.76)	4.56 (0.89)	4.42 (0.64)	7.24	.003	HFA < TD, OO
7 Would like as a roommate	3.20 (0.73)	4.40 (0.83)	3.98 (0.61)	7.48	.002	HFA < OO
8 Would like to be friends	3.79 (0.66)	4.70 (0.63)	4.49 (0.57)	6.37	.005	HFA < TD, OO
9 Physically attractive	3.91 (0.60)	4.50 (0.78)	4.24 (0.58)	2.18	.132	
10 Similar to me	3.26 (0.61)	4.13 (0.63)	3.98 (0.52)	6.63	.004	HFA < TD, OO
11 Knowledgeable	4.04 (0.54)	4.63 (0.63)	4.51 (0.70)	2.89	.072	
12 Likely has a group of friends	4.06 (0.80)	4.98 (0.52)	4.80 (0.59)	5.97	.007	HFA < TD, OO
13 Likely has a best friend	3.95 (0.81)	4.69 (0.62)	4.69 (0.69)	3.90	.032	
14 Likely to be popular	3.03 (0.87)	4.10 (0.78)	4.02 (0.81)	5.84	.008	HFA < TD, OO
TOTAL	52.97 (8.86)	64.96 (7.70)	61.47 (7.94)	6.22	.006	HFA < OO

Table 17 Modified Reysen Likability Scale—13 to 18 year olds

	HFA (N=16)	OO (N=13)	TD (N=15)	<i>F</i>	<i>p</i>	Post-hoc
1 Friendly	4.52 (0.59)	5.24 (0.36)	4.80 (0.59)	6.45	.004	HFA < OO
2 Likeable	4.18 (0.52)	5.07 (0.48)	4.90 (0.65)	10.57	<.001	HFA < TD, OO
3 Warm	3.90 (0.74)	4.76 (0.40)	4.21 (0.71)	6.40	.004	HFA < OO
4 Approachable	4.04 (0.63)	5.04 (0.36)	4.64 (0.66)	11.44	<.001	HFA < TD, OO
5 Would ask for advice	3.11 (0.43)	4.38 (0.75)	4.24 (0.67)	19.02	<.001	HFA < TD, OO
6 Would work on a school project	3.16 (0.57)	4.45 (0.65)	4.50 (0.65)	23.17	<.001	HFA < TD, OO
7 Would like as a roommate	2.74 (0.36)	3.73 (0.68)	3.81 (0.69)	15.95	<.001	HFA < TD, OO
8 Would like to be friends	3.68 (0.38)	4.56 (0.53)	4.42 (0.62)	12.84	<.001	HFA < TD, OO
9 Physically attractive	3.09 (0.38)	3.80 (0.83)	4.19 (0.75)	10.77	<.001	HFA < TD, OO
10 Similar to me	3.06 (0.44)	4.08 (0.61)	4.22 (0.59)	20.41	<.001	HFA < TD, OO
11 Knowledgeable	4.02 (0.79)	4.70 (0.62)	4.72 (0.53)	5.55	.007	HFA < TD, OO
12 Likely has a group of friends	3.98 (0.62)	4.86 (0.63)	4.97 (0.58)	11.94	<.001	HFA < TD, OO
13 Likely has a best friend	4.03 (0.60)	4.87 (0.29)	4.92 (0.58)	13.88	<.001	HFA < TD, OO
14 Likely to be popular	2.51 (0.52)	3.81 (0.83)	3.92 (0.82)	17.85	<.001	HFA < TD, OO
TOTAL	50.03 (5.05)	63.33 (7.01)	62.48 (7.64)	19.32	<.001	HFA < TD, OO

Table 18. Correlation Matrices between Likability Score, IQ Scores, ADOS Scores, and Vineland Scores

Correlation Matrix for All Groups Combined

	Age	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Likability Total	.018	.273*	.127	-.645**	-.679**	.184	.486**
Age		-.106	-.211*	-.011	-.028	-.215*	-.042
Verbal IQ			.333**	-.439**	-.391**	.305**	.235*
Performance IQ				-.206*	-.120	.271*	-.019
ADOS Communication					.538**	-.068	-.257
ADOS Socialization						-.060	-.335
Vineland Communication							-.322**

* $p < .05$, ** $p < .01$ **Correlation Matrix for OO Group**

	Age	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Likability Total	-.015	.219	.194	-.548**	-.453*	.047	.113
Age		-.044	-.080	-.022	-.007	-.143	.202
Verbal IQ			.387*	-.254	-.158	.052	.107
Performance IQ				-.190	-.189	.331	-.065
ADOS Communication					.538**	-.068	-.257
ADOS Socialization						-.060	-.335
Vineland Communication							.322

* $p < .05$, ** $p < .01$ **Correlation Matrix for HFA Group**

	Age	VIQ	PIQ	ADOS Comm.	ADOS Soc.	Vineland Comm.	Vineland Soc.
Likability Total	.001	-.039	-.039	-.223	-.374*	-.268	-.079
Age		-.189	-.286	-.033	-.027	-.260	-.076
Verbal IQ			.293	-.440**	-.276	.167	-.212
Performance IQ				-.319	-.054	.291	-.143
ADOS Communication					.455**	-.221	.132
ADOS Socialization						.137	.276
Vineland Communication							.511**

* $p < .05$, ** $p < .01$ **Correlation Matrix for TD Group**

	Age	Verbal IQ	Performance IQ	ADOS Communication	ADOS Socialization	Vineland Communication	Vineland Socialization
Likability Total	-.041	.223	.142	-.335	-.396	-.178	.254
Age		-.142	-.343*	.163	.045	-.315	-.401*
Verbal IQ			.298	-.234	-.362*	.495**	.374*
Performance IQ				-.366*	-.309	.186	.024
ADOS Communication					.509**	-.003	-.142
ADOS Socialization						-.041	-.196
Vineland Communication							.413*

* $p < .05$, ** $p < .01$

Table 19. Correlation Matrices between Likability Scores and SCICA Scales

Correlation Matrix for All Groups Combined

	SCICA Total	Anxious	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems
Likability Total	-.710**	-.062	-.617**	-.538**	-.426**	-.227
SCICA Total		.228*	.656**	.837**	.756**	.518**
Anxious			.036	.270*	.110	-.046
Withdrawn/Depressed				.373**	.230*	-.107
Immaturity					.717**	.511**
Attention Problems						.455**

* $p < .05$, ** $p < .01$ **Correlation Matrix for OO Group**

	SCICA Total	Anxious	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems
Likability Total	-.496*	.004	-.344	-.507*	-.364	.062
SCICA Total		.336	.693**	.831**	.820**	.302
Anxious			.403	.229	.071	-.024
Withdrawn/Depressed				.559**	.420*	-.280
Immaturity					.662**	.228
Attention Problems						.175

* $p < .05$, ** $p < .01$ **Correlation Matrix for HFA Group**

	SCICA Total	Anxious	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems
Likability Total	-.533**	.055	-.474*	-.332	-.237	-.079
SCICA Total		.098	.508**	.796**	.682**	.528**
Anxious			-.092	.212	-.052	-.183
Withdrawn/Depressed				.177	.024	-.187
Immaturity					.632**	.474*
Attention Problems						.428*

* $p < .05$, ** $p < .01$ **Correlation Matrix for TD Group**

	SCICA Total	Anxious	Withdrawn/ Depressed	Immaturity	Attention Problems	Self- Control Problems
Likability Total	-.634**	.047	-.582**	-.445*	.052	-.091
SCICA Total		.043	.672**	.749**	.361	.349
Anxious			-.250	.157	.366	.012
Withdrawn/Depressed				.212	-.209	-.339
Immaturity					.447*	.549**
Attention Problems						.427*

* $p < .05$, ** $p < .01$

Appendix A. Yale Adaptation of the Pragmatic Rating Scale (Y-PRS)

Pragmatic Behaviors	Speech/Prosody Behaviors	Paralinguistic behaviors
<ul style="list-style-type: none"> • Inappropriate/absent greeting • Strikingly candid • Overly direct or blunt • Inappropriately formal • Inappropriately informal • Overly talkative • Irrelevant/inappropriate detail • Out of sync content/unannounced topic shifts • Confusing accounts • Topic preoccupation/perseveration • Unresponsive to examiner's cues • Little reciprocal to-and-fro exchange • Terse • Odd humor • Insufficient background information • Failure to reference pronouns, terminology • Inadequate clarification • Vague 	<ul style="list-style-type: none"> • Scripted, stereotyped sentences or discourse • Awkward expression of ideas • Indistinct speech/mispronunciations • Rate of speech is too rapid/slow • Intonation is unusual • Volume is inappropriate • Unusual timing of responses, reformulations • Unusual rhythm of speech such as stuttering 	<ul style="list-style-type: none"> • Physical distance • Gestures • Facial expressions • Gaze

Rating scale: 0=occurs almost never, 1=occurs sometimes, 2=occurs almost always, cnr=could not rate, n/o=no opportunity to rate

Appendix B. Semistructured Clinical Interview for Children & Adolescents (SCICA)
Observation Form

Anxious	Withdrawn/Depressed	Language/Motor Problems (Immaturity)
<ul style="list-style-type: none"> • Asks for feedback on performance • Can't get mind off certain thoughts • Feels too guilty • Is afraid of making mistakes • Lacks self-confidence or makes self-deprecating remarks • Nervous, highstrung, or tense • Nervous movements, twitching, tics, or other unusual movements • Overly anxious to please • Seems too dependent on interviewer • Self-conscious or easily embarrassed • Too concerned with neatness, cleanliness, or order • Too fearful or anxious • Worries 	<ul style="list-style-type: none"> • Apathetic or unmotivated • Avoids eye contact • Limited conversation • Limited fantasy or imagination • Refuses to talk • Reluctant to discuss feelings/personal issues • Says "don't know" a lot • Secretive, keeps things to self • Seems overtired or fatigued • Seems unresponsive to humor • Slow to respond verbally • Slow to warm up • Stares blankly • Underactive or slow moving • Unhappy, sad, or depressed • Unusually quiet voice • Withdrawn 	<ul style="list-style-type: none"> • Giggles too much • Acts too young for age • Concrete thinking • Fine motor difficulty • Gross motor difficulty or clumsy • Lapses in attention • Mouth movements while writing/drawing • Needs repetition of instructions or questions • Perseverates on a topic or task
Self-Control Problems	Attention Problems	
<ul style="list-style-type: none"> • Acts overly confident • Bragging, boasting • Defiant, talks back, or sarcastic • Impulsive or acts without thinking • Laughs inappropriately • Shows off, clowns, or acts silly • Strange behaviors • Talks too much • Unusually loud 	<ul style="list-style-type: none"> • Complains of tasks being too hard or upset by tasks • Contradicts or reverses own statements • Doesn't concentrate or pay attention for long on tasks, questions, topics • Doesn't sit still, restless, or hyperactive • Easily distracted by external stimuli • Fidgets • Frequently off-task • Messy work • Out of seat • Wants to quit or does quit tasks 	

Rating scale: 0=no occurrence, 1=slight/ambiguous occurrence, 2=definite occurrence with mild to moderate intensity, 3=definite occurrence with severe intensity

Appendix C. Modified Version of Reysen Likability Scale

1. This person is friendly.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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2. This person is likeable.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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3. This person is warm.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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4. This person is approachable.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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5. I would ask this person for advice.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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6. I would like this person as a coworker or as a partner on a school project.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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7. I would like this person as a roommate.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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8. I would like to be friends with this person.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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9. This person is physically attractive.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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10. This person is similar to me.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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11. This person is knowledgeable.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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12. This person likely has a group of friends.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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13. This person likely has a best friend.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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14. This person is likely to be popular.

Very Strongly Disagree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Very Strongly Agree
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