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Social Metaperception in High Functioning Adolescents with Autism

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Children and adolescents with high functioning autism (HFA) display social deficits despite their average IQ levels. Social metaperception, or one's ability to perceive what a social partner thinks of oneself during a social interaction, is hypothesized to support social competence. In this study, the novel Perceptions and Metaperceptions Questionnaire was designed to quantify and compare social metaperception abilities in adolescents with and without HFA. For all adolescents, accuracy of social metaperceptions (how well they matched with peer's ratings) was unrelated to theory of mind abilities. All adolescents' perceptions of their peers were associated with their metaperceptions. Interestingly, HFA adolescents tended to exhibit accurate metaperceptions, but typically developing adolescents did not. Although social metaperception *accuracy* did not relate to observed social competence, the ways that adolescents were perceived by peers, as well as the way they believed they were perceived by peers, influenced social competence. Findings extend our understanding of typically and atypically developing adolescents' perceptions of peers and their dynamic abilities to discern what a social partner thinks of them. Further, findings inform existing interventions targeting social skills and social pragmatics training for individuals with HFA.

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CHAPTER ONE

INTRODUCTION

Children and adolescents with high functioning autism (HFA) display mild to moderate social deficits despite their average levels of IQ (Bauminger & Kasari, 2000). One mechanism hypothesized to support social competence is social metaperception, or the ability to perceive what a social partner thinks of oneself during a social interaction. Despite a potential link with theory of mind, which is often impaired in HFA, social metaperception has not been studied in individuals with HFA. In this study, social metaperception abilities were quantified and compared in dyadic interactions of adolescents with and without HFA using a novel measure of social metaperception. Associations were examined between social metaperception abilities and both theory of mind and observed social competence, hypothesizing that social metaperception would be supportive of better theory of mind as well as better social competence for both members of a dyad.

Social Metaperception

Laing and colleagues (1966) conceptualized interpersonal perception as one person thinking about another person's experiences. Laing coined the term *metaperception* to refer specifically to a person's ability to think about another person's judgments of oneself (Laing et al., 1966; see Figure 1). In this study, the term *social* metaperception will be used to specify the awareness of others' judgments of oneself during a social interaction. Social metaperception, also referred to as reflected self-appraisal (Pfeifer et al., 2009), involves the ability to see oneself from another individual's perspective (Oltmanns, Gleason, Klonsky, & Turkheimer, 2005), typically assessed in dyadic interactions (e.g., Cooper, 2005; Elfenbein, Eisenkraft, & Ding, 2009).

Social cognition, encompassing the cognitive processes that influence people's perceptions of each other in social situations includes the separate but related concepts of theory of mind and metaperception. Theory of mind refers to the ability to ascribe mental states such as beliefs and emotions to oneself and to others (Baron-Cohen, 2001). This cognitive ability allows a person to make metaperceptions as well as predictions about a person's future behavior during a social interaction. Although theory of mind and social metaperception are conceptually related, metaperception is a more advanced and integrative skill that involves the coordination of perceptions of the self and others.

Measurement of Social Metaperception

There is currently no standardized measure for social metaperception. Previous studies have included indices of social metaperception based on questionnaires with few items (Pozo, Carver, Wellens, & Scheier, 1991; Sherman et al., 2001). For instance, Pozo and colleagues (1997) investigated "social perception" using two questions indexing global impressions on 7-point scales: "In your opinion, how negatively or positively does this person feel about you right now?" and "How interested do you think this person is in getting to know you?" Adults with high self-reported social anxiety predicted lower perceived acceptance by a research study confederate than did adults with low anxiety. In a study examining social metaperception in college-age adults interacting with a confederate "interviewer," Kaplan and colleagues (2009) had participants predict how they thought interviewers rated them on the following five items: intelligence, shy versus outgoing, good versus average person, having clearly defined goals, and unsure versus confident. Participants spoke their responses aloud to a video camera, and responses were transcribed and coded for global positivity. In addition, participants wrote responses to an

open-ended global social metaperception item, “In one or two sentences, please write your impression of what the interviewer thought about you.” Researchers have operationalized social metaperception in several ways, and the lack of a standard measure makes comparisons across studies or samples challenging.

Social Metaperception Accuracy

Social metaperception accuracy (sometimes referred to as “meta-accuracy,” e.g., Sherman et al., 2001; Carlson & Kenny, 2012) refers to the extent to which social metaperceptions are congruent with social partner’s perceptions. While measures indexing social metaperception answer the question “What do people think that others think of them?” indices of social metaperception *accuracy* answer the question “Do people know what others think of them?” Like measurement of social metaperception, measurement of accuracy is carried out using a number of different analytic methods in the literature.

Sherman et al. (2001) examined social metaperception accuracy in adults using ten items on 7-point scales ranging from “very little” to “very much.” Five questions measured perceptions of a peer, including “How much do you like this person?” and “How much in common do you think you have with this person?” Five questions measured social metaperceptions, including “Based on your interactions with the other people in the study, how much do you think they like you?” and “Based on your interactions with the other people, how much do you think they feel they have in common with you?” Using an ANOVA analytic framework, researchers found that adults tended to believe they were perceived more positively than they actually were, exhibiting a

positivity bias. The bias toward ascribing positive traits to oneself is hypothesized to be adaptive, promoting a confident sense of self as well as facilitating positive social interactions (Beer, 2014).

In a study examining social metaperception accuracy in children, (Malloy, Albright, & Scarpati, 2007) asked groups of children in grades 1 through 6 to rate their peers and predict their peers' ratings of themselves on eight dimensions, including behavior, popularity, and happiness, amongst others, on 7-point scales. Researchers used a round robin design in which individuals in a group rate and are rated by all other individuals. Social relations analysis, which allows for partitioning of both variance from specific social partners as well as averaged across social partners, revealed that school age children were accurate in their predictions of how other students in the classroom (taken as a group) viewed them.

Individual Differences in Metaperception Accuracy

Malloy and colleagues (2007) found that although children were generally able to form accurate social metaperception, the ability was more accurate for 11- and 12-year-olds than for 7- to 10-year-olds. They pointed to changes in cognitive development and interpersonal understanding during childhood as potential influences on the development of metaperception accuracy. Specifically, during early childhood, increases in neural connectivity aid children in forming mental representations and allow for interpersonal communication and interpretation of other's mental states (Hudspeth & Pribram, 1990; Siegel, 2001). Interruptions in neural integration, such as those observed in children with ASD, in combination with atypical social-communicative experiences may have a reciprocal relation that reinforces the negative cycle (Siegel, 2001).

Social Metaperception in Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by early-appearing atypicalities in social and communicative behaviors and restricted or repetitive behaviors and interests that appear early, reducing adaptive functioning levels and quality of life (American Psychiatric Association, 2013; Shipman, Sheldrick, & Perrin, 2011). The study of social cognition in individuals with HFA may provide insight into mechanisms that support or hinder social competence development (Garfield, Peterson, & Perry, 2001). Despite intact performance on theory of mind measures, individuals with HFA have difficulty in social interactions, suggesting that the flexible implementation of social skills during social interactions involves more complicated processes in addition to theory of mind (Scheeren, de Rosnay, Koot, & Begeer, 2013). Real-world interactions are fast-paced, dynamic encounters during which individuals must be able to read a social partner's cues and adapt their behavior in response. This requires individuals to quickly interpret not only general social cues but cues relating to their own behavior. Accurate metaperception requires self-monitoring and allows individuals to modify behaviors in response to moment-to-moment perceived social partner expectations.

During social interactions, individuals multitask by attending to social partners' cues as well as planning their own behaviors and responses. The "cognitive busyness" (Gilbert, Pelham, & Krull, 1988) occurring during social exchanges may be particularly salient for individuals with HFA. Social competence issues may become exacerbated during adolescence, a transitional period that poses challenges to most individuals as social environments become less structured than those of childhood (Parker, Rubin,

Erath, Wojslawowicz, & Buskirk, 2006). The effortful nature of a social interaction may not permit the cognitive flexibility necessary for the formation of accurate metaperception. Instead, individuals may form faulty or incomplete metaperceptions that are not in line with what the social partner is actually thinking.

Social Metaperception and Social Competence

Social metaperception aids people in responding appropriately during interactions (Carlson & Kenny, 2012). Theory of mind, or the ability to assign mental states to others (Baron-Cohen, 2001), is one factor that contributes to social competence, but processes beyond theory of mind are involved in dynamic social interactions (Klin, 2000). In other words, theory of mind is hypothesized to be necessary, but not sufficient for, social metaperception. Despite the link with theory of mind, social metaperception has not been studied in individuals with HFA.

Theory of mind is associated with social skills and competence in individuals with ASD. Gillespie-Lynch and colleagues (2012) found that joint attention in infancy, conceptualized as a precursor to theory of mind, was positively associated with parent-reported adult social functioning. In another study examining the validity of a parent-reported inventory of typically developing children's theory of mind, theory of mind was found to be positively related to concurrent parent-reported social skills (Lerner, Hutchins, & Prelock, 2011). Still, there is evidence that theory of mind is not the primary factor influencing children's social skills. For example, one study found that an assessment of theory of mind was not associated with either parent-reported social skills or observed social behavior in typically developing children (Newton & Jenvey, 2011). Baron-Cohen (2001) proposed that although theory of mind is necessary for adaptation to

the demands of social interactions, dynamic contextual cues must also be taken into consideration in order to be socially competent.

Given evidence that theory of mind does not account for all variation in social competence, other within child characteristics must be involved (Klin, 2000). Social metaperception may be associated with social competence in individuals with ASD, and may explain some variability in social competence over and above theory of mind. Hypothesized benefits of accurate social metaperception include increasing self-knowledge and positive behavioral changes in response to social partners' cues (Carlson & Kenny, 2012).

Furthermore, accuracy of social metaperception supports the fluidity and reciprocity of social interchanges. Evocative effects describe the effects of a person's characteristics on a social partner's behavior (Cook & Kenny, 2005). Individuals with ASD display low cognitive flexibility (Kissine, 2012); therefore, the ability to notice and respond to a social partner's cues may be helpful for individuals with HFA who are dependent on social scaffolding during a social interaction. However, the social competence of an adolescent with HFA may provide an additional benefit for their social partners by creating a more predictable and reciprocal interchange. Thus, each individual's metaperception abilities may support the social competence of the peer.

Present Study

The peer interaction paradigm employed in this study allowed for in-vivo observations of a social interaction with an unfamiliar peer. Adolescents' theory of mind abilities was indexed by two standard assessment of theory of mind. Perceptions and social metaperceptions were measured immediately following a five-minute unfamiliar peer interaction using a novel self-report questionnaire designed for this study. Ratings of liking and disliking from peers, as well as metaperceptions of being liked and disliked, were primary variables of interest, as liking and disliking have been traditionally examined as distinct aspects of individuals' social adaptation with peers in the sociometric literature (Gest, Graham-Bermann, & Hartup, 2001; Košir & Pečjak, 2005), and are often examined in the social metaperception literature (e.g., Pozo et al., 1991). The association between theory of mind and social metaperception was assessed. Accuracy of social metaperception was examined as a predictor of adolescents' own social competence, providing information about the influence of social-cognitive factors in typically and atypically developing adolescents. Social metaperception accuracy was also used as a predictor of peers' social competence, to examine whether there were evocative effects occurring during the social interactions.

There is a lack of research on metaperception in individuals with HFA, and this study's findings contribute to the understanding of social cognitive processes that occur during an actual social interaction. Findings extend both basic and applied research examining factors that contribute to variability in social competence in adolescents with HFA. Findings also lay the groundwork for future research to increase the impact of social skills trainings, which is often limited, with parents infrequently reporting

generalized improvements in social competence outside of the intervention setting (i.e., in school or at home; for a review, see Williams White, Keonig, & Scahill, 2007). Metaperception is a within child characteristic that has the potential to be the focus of interventions aimed at social skills improvement for adolescents with HFA.

Specific Aims

Aim 1: Examine the relation between theory of mind and social metaperception accuracy in both adolescents with and without HFA.

Hypothesis 1: Theory of mind and social metaperception accuracy are predicted to be moderately correlated.

Aim 2: Examine social metaperception accuracy in adolescents with and without HFA.

Hypothesis 2: Adolescents with HFA will show greater discrepancy between their social metaperceptions and their peers' actual ratings than will adolescents without HFA. Exploratory analyses will examine the direction of this effect.

Aim 3: Examine the effects of one's own and one's partner's metaperception accuracy on one's own social competence.

Hypothesis 3: Metaperception accuracy is hypothesized to be supportive of one's own social competence and of competence elicited from the peer for both adolescents with HFA and adolescents without HFA.

CHAPTER TWO

METHOD

Participants

Participants were part of a larger study investigating social and behavioral functioning in adolescents with and without HFA. The final sample consisted of 25 dyads (48 individuals: 25 HFA, 25 comparison; COM). Participants were between 12 and 16 years of age (M_{age} = 14.40, SD = 1.41). See Table 1 for sample characteristics. Recruitment for participants with HFA was carried out through emails sent to families through the Center for Autism and Related Disabilities (CARD) at the University of Miami. Recruitment for COM adolescents was completed using 1) a commercially available list of families in the community with children in the appropriate age range, and 2) contact with students through the Miami-Dade County Public Schools system.

Adolescents were included in the HFA group if they had a community diagnosis and met diagnostic criteria for ASD (score of 7 or above) on the Communication + Social Interaction Total score of the Autism Diagnostic Observation Schedule (ADOS; Lord, 2002) *and* met diagnostic criteria for ASD on one of two diagnostic questionnaire criteria: Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles, & Bailey, 1999; clinical cutoff > 12) and Autism Spectrum Screening Questionnaire (ASSQ; Ehlers, Gillberg, & Wing, 1999; clinical cutoff > 13). In this sample, three HFA participants were excluded for not meeting ASD diagnostic criteria on the ADOS. One COM participants was excluded for meeting criteria for ASD on the SCQ. Each participant completed a verbal IQ assessment and four participants with verbal IQ scores below 70 were excluded from participation in order to ensure high functioning samples.

Procedure

This study was approved by the University of Miami Institutional Review Board (ID 20120830). Parents and adolescents completed written informed consent and assent procedures, respectively, in the laboratory. A brief version of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003), comprised of Vocabulary and Similarities subtests, was administered to obtain an estimate of verbal IQ for eligibility and matching purposes. Parents completed the SCQ and ASSQ. A theory of mind assessment, described below, was completed with each participant individually.

In a second visit in the laboratory, adolescents with HFA were paired with an unfamiliar COM peer (matched on gender, age, and verbal IQ) for an unstructured social interaction. Previously developed coding schemes from our laboratory were adapted to quantify global social competence during the interaction (Usher, Burrows, Schwartz, & Henderson, 2015). Immediately following this task, each participant completed a questionnaire rating the social partner on several characteristics (perceptions) and how he/she believed the peer answered the same questions about him/herself (social metaperceptions). See the Appendix for the full measure. Dyads completed additional social interaction tasks not reported here.

Measures

Intelligence. The Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003) is a standard measure of intelligence used for children 6 to 16 years of age. A brief version of the Wechsler Intelligence Scale for Children-Fourth Edition, comprised of the Vocabulary and Similarities subtests, was administered to all participants to obtain a verbal comprehension index (VCI). These scales have high

loadings on the VCI factor, strong test-retest reliabilities, and good internal consistencies among the WISC-IV scales (Williams, Weiss, & Rolfhus, 2003).

Parent-Reported High Functioning Autism Symptoms. The Autism Spectrum Screening Questionnaire (ASSQ; Ehlers et al., 1999) is a 27-item instrument intended to screen for symptoms of HFA. Raters are asked to indicate whether a child "stands out as different from other children of his/her age" on each item by choosing "no," "somewhat," or "yes." Scores range from 0-54, with higher scores indicating more HFA symptoms. For this study, a cutoff score of 13 was used.

Observed Autism Symptoms. The Autism Diagnostic Observation Schedule (ADOS; Lord, 2002) is an observational assessment that consists of a series of semi-structured activities intended to elicit social, communication, and repetitive behaviors associated with ASD. The four modules of the ADOS are designed for use with individuals at particular developmental and language ability levels. For this study, all participants received a Module 3, which is intended for verbally fluent children and younger adolescents. Items on the ADOS are typically scored from 0 (no evidence of abnormality) to 3 (markedly abnormal behavior), thus higher domain scores indicate more abnormal behaviors. The ADOS was administered by two students with a minimum of master's level training who had attended ADOS training. After administration, all scores were reviewed by a research-reliable individual. The Communication + Social Interaction Total score were used to verify diagnostic status, and a cutoff of 7 (combined score) was used.

Parent-Reported Autism Symptoms. The Social Communication Questionnaire (SCQ; (Berument et al., 1999) is a parent report instrument for the screening or

verification of ASD symptoms in children. It was developed from the 40 critical items of the Autism Diagnostic Interview (Lord, Rutter, & Le Couteur, 1994), compiled into a parent report questionnaire (Berument et al., 1999). Parents choose "yes" or "no" in response to 40 questions regarding children's current behavior as well as behavior between the ages of 4 and 5 years. For this study, the Lifetime SCQ total score was used as a measure of individual differences in ASD symptoms, and a cutoff of 12 was used.

Theory of Mind. The Strange Stories task (Happé, 1994) consists of 12 vignettes that assess the ability to attribute mental states to others. Participants were asked a comprehension question to confirm understanding of story events ("Was it true, what __ said?"), followed by an open-ended question about why the story events happened in that way ("Why did __ say that?"). The comprehension question were scored as either correct or incorrect. The open-ended question was recorded in writing and audiotaped for later coding of participants' best answers as either correct or incorrect. A summary score was computed by adding the comprehension question correct responses to the open-ended correct responses. Higher scores indicate more advanced theory of mind abilities.

The Reading the Mind in the Eyes task (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001) assesses the ability to recognize facial affect in 28 photographs of the eye region of different adult faces. Participants were asked to pick which of four words best describes what the person in each photo is thinking or feeling. Responses were scored as either correct or incorrect. Higher scores indicate more advanced theory of mind abilities.

Perceptions and Metaperceptions. The 52-item Perceptions & Metaperceptions Questionnaire, designed for this study based on previous research (e.g., Pozo et al., 1991;

Sherman et al., 2001) was given to each participant immediately following the *Get to Know You* Task. Items rated on a 5-point scale from 1 (not at all) to 5 (the most) were designed to elicit information about perceptions (e.g., "How happy is __?") and social metaperceptions (e.g., How boring does __ think you are?"). Items were split between positively-valenced (e.g., polite) and negatively-valenced items (e.g., uncool). In addition, two items assessed each participant's global evaluation of the interaction ("How well did your interaction with __ go overall?" and "How much would you want to continue a friendship with __ outside of the lab?").

For purposes of clarity, I will use the terms "like" and "dislike" to differentiate valenced adjectives. For example, positively-valenced perceptions reflect a person's ratings of liking for his/her peer, while negatively-valenced perceptions reflect a person's ratings of dislike for the peer. Positively-valenced metaperceptions reflect a person's prediction of their peer's liking rating, and negatively-valenced metaperceptions reflect a person's predictions of peer's rating of dislike.

Observed Social Competence. During the Get to Know You Task, each dyad was left sitting at a table together in the laboratory observation room and told that they had five minutes to "get to know each other." Video recorded interactions were coded for each participant's proportion of time talking and frequency of sharing ideas. Global eye contact, conversational efficacy (turn-taking, answering and asking questions), and appropriateness were coded on 5-point scales ranging from 1 (completely inappropriate) to 5 (appropriate throughout). Data reduction techniques described below were used to reduce the number of variables used in subsequent analyses, in accordance with previous practices used in our laboratory (Usher et al., 2015). Composite scores were computed by

standardizing and averaging social competence variables. See Table 2 for an abbreviated description of codes.

All recorded interactions were double-coded by trained researchers and interrater reliability was achieved with single measures intraclass correlation coefficient ranging from .60 to .97 and average measures intraclass correlations ranging from .75 to .99. Past single measures intraclass correlations for this task from our laboratory ranged from .70 to .96 (Usher et al., 2015). For this study, because the observed social competence composite scores obtained using single and averaged codes were highly correlated (rs $\geq$ .92), results are reporting using averaged scores from both coders.

Analytic Approach

Aim 1. Pearson correlations were used to examine the associations between theory of mind and social metaperception accuracy.

Aim 2. Actor-Partner Interdependence Model (APIM) analyses were used to examine the effect of an adolescent's perception of the peer on his/her own metaperceptions (actor effect), as well as the effect of the peer's perceptions on the adolescent's metaperceptions (partner effect).

Aim 3. APIM analyses were used to examine the effects of one's own (actor effect) and one's partner's (partner effect) metaperception accuracy on one's own social competence.

The Actor-Partner Interdependence Model (Cook & Kenny, 2005; Kashy & Kenny, 2000) is a type of multilevel modeling used to analyze associations between the two members of a dyad. This method is less biased for dyadic analyses than statistical tests that require assumptions of independence, such as hierarchical regression analysis

(Kenny & Ledermann, 2010). The APIM addresses the fact that an individual in a dyad may be more similar to his/her partner than to individuals from other dyads (i.e., dyad members scores are interdependent). In the APIM, the unit of analysis is the dyad. Individuals' scores are treated as repeated measures within the dyad because each dyad member contributes both actor and partner effects. Actor effects refer to a person's effects on their own behavior, and partner effects refer to the partner's effects on the person's behavior.

Two separate models may be run for each analysis. The first tests for group differences – in this case, differences between adolescents with and without HFA. Nonindependence is included in the equation as a random intercept at the dyad level, which allows intercepts for dyads to vary. This accounts for the variation in the dyad over and above residual variance. In contrast, slopes are constrained to be equal across dyads. If there is evidence of significant differences between groups, the second model is run to provide separate coefficient estimates for each group, in this case by including diagnostic group as a dummy coded covariate. In the second model, significance tests are used to assess whether coefficients are different from zero. Compound Symmetry Heterogeneous (CSH) is used as the covariance structure to allow for different error variances for HFA and COM.

In the second model of each analysis, one equation is estimated for each member of a dyad, with the person's own predictor variable as well as their partner's predictor variable. For Aim 2, the equation is as follows: Actor $\text{Metaperception}_{ij} = (b_0 + d_j) + (b_1)\text{Actor Group} + (b_2)\text{Actor PerceptionC}_{ij} + (b_3)\text{Partner PerceptionC}_{ij} + (b_4)\text{Actor Group*Actor PerceptionC}_{ij} + (b_5)\text{Actor Group} + \text{Partner PerceptionC}_{ij} + e_{ij}$, where b_0 is

the predicted metaperception for a person whose perception score is zero (with grand mean centering of predictors, this is a person whose perceptions were at the average). b_1 is the group difference on the DV – does metaperception differ for adolescents with and without HFA? Given coding, if positive, it indicates that HFA participants (1) have higher metaperceptions than COM participants (-1). b_2 is the average actor effect: Do adolescents with higher perceptions of their partners have higher metaperceptions? b_3 is the average partner effect: Do adolescents whose partners rate them more positively have higher metaperceptions? b_4 is the group difference for the actor effect. Is the effect of higher perceptions of the peer on a person's own metaperceptions stronger for HFA versus COM? b_5 is the group difference for the partner effect: Is the effect of having a partner who rates you more positively on a person's metaperceptions stronger for HFA versus COM [Aim 2 test of interest]?

For Aim 3, the equation is as follows (separate models for social competence variables of Social Reciprocity and Social Initiative): Actor Social $\text{Competence}_{ij} = (b_0 + d_j) + (b_1)\text{Actor Group} + (b_2)\text{Actor Metaperception AccuracyC}_{ij} + (b_3)\text{Partner Metaperception AccuracyC}_{ij} + (b_4)\text{Actor Group*Actor Metaperception AccuracyC}_{ij} + (b_5)\text{Actor Group} + \text{Partner Metaperception AccuracyC}_{ij} + e_{ij}$, where b_0 is the predicted social competence for a person whose metaperception accuracy score was at the average. b_1 is the group difference on the DV – does social competence (Social Reciprocity or Social Initiative) differ for adolescents with and without HFA? Given coding, if positive, it indicates that HFA participants (1) have higher social competence than COM participants (-1). b_2 is the average actor effect: Do adolescents with higher metaperception accuracy have higher social competence? b_3 is the average partner effect:

Do adolescents whose partners have higher metaperception accuracy display higher social competence? b_4 is the group difference for the actor effect. Is the effect of higher metaperception accuracy on a person's own social competence stronger for HFA versus COM [Aim 3 test of interest]? b_5 is the group difference for the partner effect: Is the effect of having a partner with higher metaperception accuracy on a person's social competence stronger for HFA versus COM [Aim 3 test of interest]?

CHAPTER THREE

RESULTS

Preliminary Analyses and Data Reduction

All analyses were conducted in IBM SPSS Version 22. See Table 3 for descriptive statistics for all primary variables. See Tables 4 and 5 for correlations between all primary variables for the HFA group and for the COM group, respectively.

Observed Social Competence. Inter-relations among individual observed behavioral codes were examined using Principal Component Analysis (PCA; Abdi & Williams, 2010). Variables were entered into a PCA using a Varimax rotation and a two-factor solution was specified in accordance with previous findings (Usher et al., 2015). Proportion of time talking, latency to first utterance (reversed), latency to first spontaneous utterance (reversed), and sharing loaded onto the first factor, labeled *Social Initiative*. Seeking, eye contact, conversational efficacy, and social ease loaded onto the second factor, labeled *Social Reciprocity*. See Table 6 for eigenvalues and loadings. Composite scores were created by standardizing and averaging the variables that loaded onto each component identified through PCA.

Perceptions and Metaperceptions. Cronbach's alpha reliability coefficients for the Perceptions and Metaperceptions Questionnaire were examined separately by diagnostic group to determine whether individuals with and without HFA responded consistently to the items. For HFA participants, values for Cronbach's α were as follows: .94 for positively-valenced perceptions, .80 for negatively-valenced perceptions, .95 for positively-valenced metaperceptions, and .85 for negatively-valenced metaperceptions. For COM participants, values for Cronbach's α were as follows: .86 for positively-

valenced perceptions, .60 for negatively-valenced perceptions, .89 for positively-valenced metaperceptions, and .76 for negatively-valenced metaperceptions.

Mean scores on raw perceptions and metaperceptions were comparable for adolescents with and without HFA. See Table 3 for means and standard deviations. Across both diagnostic groups, adolescents generally reported liking their social partners more than they disliked them. Likewise, all adolescents predicted that their social partners liked them more than they predicted they disliked them. For both adolescents with and without HFA, ratings of liking and disliking were moderately correlated, as were ratings of metaperceptions of being liked and disliked, indicating that the constructs were related but distinct.

For adolescents with HFA, raw perception and metaperception scores had acceptable values for skew and kurtosis (ranging from -1 to 1). For COM adolescents, most scores had acceptable skew and kurtosis, but negative metaperceptions was highly skewed (2.55) and kurtotic (9.18). Examination of the distribution of negative metaperceptions for COM adolescents revealed one participant with an extreme value of 47. Skew and kurtosis values calculated without this individual fell within the normal range (-1 to 1).

Standardized difference scores (SDSs, De Los Reyes, 2013; 2004) were calculated to quantify social metaperception accuracy. First, social metaperception and perception raw totals were standardized across all participants. Then, for each participant z-scores on peer perceptions were subtracted from the participant's z-scores on metaperceptions, resulting in an SDS for each participant (metaperception - peer's perception = SDS). This process was completed for both positively- and negatively-

valenced adjectives. Higher scores indicate that individuals predicted that their peers rated them as *more* positive (liked them more) or *more* negative (disliked them more) than their peers actually did. Lower scores indicate that individuals predicted that their peers rated them as *less* positive or *less* negative than they actually did.

Hypothesis Testing

Theory of Mind and Social Metaperception Accuracy

Aim 1: Examine the relation between theory of mind and social metaperception accuracy in both adolescents with and without HFA.

Bivariate correlation analyses were conducted to examine the association between theory of mind and metaperception accuracy. There were no significant correlations between the Reading the Mind in the Eyes or Strange Stories and SDSs for HFA or COM participants. In addition, there were no significant mean differences between adolescents with and without HFA on either theory of mind assessment. See Tables 4 and 5.

Social Metaperception Accuracy

Aim 2. Examine social metaperception accuracy in adolescents with and without HFA.

The APIM (Figure 2) was used to examine the effect of an adolescent's perception of his/her peer on his/her own metaperceptions (actor effect: horizontal associations), and the effect of the peer's perceptions on the adolescent's metaperceptions (partner effect: diagonal associations). For Aim 2, the partner effect models interdependence between participants' metaperceptions and their partners' perceptions of them, an index of accuracy of metaperceptions. Predictors were grand mean centered PAMQ perception scores, and outcomes were metaperception scores. One model was

conducted for positively-valenced adjectives and one for negatively-valenced adjectives. Results for all models can be found in Table 7.

Positively-valenced adjectives. There were no significant differences between mean predictions of peers' liking ratings (positively-valenced metaperceptions) of adolescents with HFA (M = 41.67, SD = 12.27) and those of COM adolescents (M = 44.44, SD = 9.36), b = -1.81, $t(21)$ = -1.28, p = .22. The APIM revealed a significant effect of all adolescents' ratings of liking of peers on their own metaperceptions, b = .66, $t(28)$ = 4.19, $p < .001$, controlling for the effect of the peers' liking ratings. This indicates that overall, participants who liked their peers more predicted that their peers liked them more (controlling for the peers' ratings of liking).

Although there was no significant main effect of the partner's liking ratings on adolescents' metaperceptions, the effect of the partner's liking ratings on adolescents' metaperceptions differed by group, b = .32, $t(36)$ = 2.34, p = .03. For COM adolescents, ratings of how much HFA peers liked them did not relate to how COM adolescents' believed they were liked, b = -.15, β = -.13, $t(21)$ = -.87, p = .39, suggesting lack of accuracy. However, for HFA adolescents, the association was marginally significant. The more peers liked adolescents with HFA, the more adolescents with HFA tended to believe their peers liked them, b = .50, β = .43, $t(21)$ = 2.02, p = .06, suggesting contrary to hypotheses that adolescents with HFA tended to be more accurate than COM adolescents in their metaperception accuracy. See Figure 3.

Negatively-valenced adjectives. Analyses revealed a significant main effect of adolescents' dislike ratings of their peers on their metaperceptions of dislike, b = .73,

$t(31) = 4.40$, $p < .001$, indicating that the more adolescents disliked peers, the more they thought their peers disliked them. This effect was not moderated by group.

There was no significant association between peers' dislike ratings on adolescents' metaperceptions of dislike; nor were there significant interactions by group. This suggests that all adolescents, regardless of diagnostic group, were not accurate in their metaperceptions of dislike.

Social Metaperception Accuracy and Social Competence

Aim 3. Examine the effects of one's own and one's partner's metaperception accuracy on one's own social competence.

Four separate APIMs were used to examine the effect of an adolescent's own metaperception accuracy on his or her own observed social competence and the effect of the peer's metaperception accuracy on the adolescent's social competence: 1) Positive metaperception accuracy → Social Reciprocity, 2) Negative metaperception accuracy → Social Reciprocity, 3) Positive metaperception accuracy → Social Initiative, and 4) Negative metaperception accuracy → Social Initiative. Path coefficients for all four models are listed in Tables 8 and 9.

Predictors were metaperception accuracy (as indexed by SDSs), and outcomes were composite scores of observed Social Reciprocity and Social Initiative.

Positive metaperception accuracy → Social Reciprocity. Results indicated a significant effect of diagnostic group, $b = -.31$, $t(21) = -3.60$, $p = .021$. This indicated that overall, adolescents with HFA displayed lower Social Reciprocity ($M = -.31$, $SD = .84$) than did COM adolescents ($M = .31$, $SD = .55$). However, there were no significant effects of metaperception accuracy on Social Reciprocity for either group.

Negative metaperception accuracy → Social Reciprocity. Results duplicated the above finding that adolescents with HFA displayed lower Social Reciprocity than COM adolescents, but revealed no significant effects of metaperception accuracy on Social Reciprocity.

Positive metaperception accuracy → Social Initiative. There were no significant effects of metaperception accuracy on Social Initiative.

Negative metaperception accuracy → Social Initiative. There were no significant main effects of metaperception accuracy on Social Initiative.

Exploratory Analyses Predicting Observed Behavior. Counter to hypotheses, the discrepancy between metaperception and peer's perceptions (i.e., metaperception accuracy) was not predictive of observed social competence. In order to probe the nonsignificant findings, separate APIMs were conducted with raw perception and metaperception scores as predictors of Social Reciprocity and Social Initiative. These analyses were conducted to examine whether raw perception and metaperception ratings had unique effects on observed social competence, as the above analyses indicated that the *discrepancy* between the two did not. For each of the following analyses, predictors were grand mean centered adolescent metaperception scores and partner perception scores, and outcomes were social competence composite variables. Path coefficients for all four models are listed in Tables 10 and 11.

Positive perception and metaperception → Social Reciprocity. Results revealed that overall, adolescents who predicted that their peers liked them more displayed higher Social Reciprocity, $b = .03$, $t(33) = 3.13$, $p = .004$. In addition, adolescents whose peers reported liking them more tended to display more Social

Reciprocity, $b = .02$, $t(32) = 1.77$, $p = .09$. Diagnostic group did not moderate this association, indicating that associations within groups were similar.

Negative perception and metaperception → Social Reciprocity. The APIM revealed that across the full sample, the more adolescents predicted their peer to dislike them, the less Social Reciprocity adolescents displayed, $b = -.03$, $t(34) = -2.40$, $p = .02$. This association did not differ by diagnostic group.

Positive perception and metaperception → Social Initiative. Adolescents who thought their peers liked them more displayed significantly more Social Initiative, $b = .03$, $t(37) = 3.09$, $p < .01$. This association did not differ by group.

Negative perception and metaperception → Social Initiative. Adolescents whose partners disliked them more displayed significantly less Social Initiative, $b = -.05$, $t(36) = -.02$, $p < .01$. This association did not differ by group.

CHAPTER FOUR

DISCUSSION

The overarching goals of this study were to quantify and compare social metaperception abilities in adolescents with and without HFA following a dyadic social interaction, and to evaluate how social metaperception abilities related to theory of mind and observed social competence with an unfamiliar peer. The novel Perceptions and Metaperceptions Questionnaire was designed to provide a reliable and ecologically-valid index of adolescents' perceptions of each other as well as their metaperceptions. For all adolescents, there were significant associations between their ratings of liking peers and their metaperceptions of being liked by peers, and between disliking of peers and metaperceptions of being disliked by peers. Surprisingly, the only evidence for metaperception accuracy was for adolescents with HFA, whose metaperceptions were marginally associated with peers' ratings of liking. Contrary to hypotheses, social metaperception accuracy did not significantly relate to performance on standard theory of mind tasks or independent ratings of social competence during the dyadic interaction.

Psychometrics of Perceptions and Metaperceptions Questionnaire

The measure of social metaperception created for this study demonstrated acceptable reliability for both COM adolescents and those with HFA, indicating that adolescents are able to respond consistently to similar items on the measure. For all adolescents, reliability for negatively-valenced adjectives, though adequate, was lower than it was for positively-valenced adjectives. This indicates that all adolescents were less consistent in their responses to negatively-valenced perceptions and metaperceptions. Perhaps some of the adjectives that we considered to be "negative" were interpreted in different ways by different adolescents. There is evidence that children and adolescents

with HFA differ from typically developing children and adolescents in their ratings of "pleasantness" of images designed to be pleasant or unpleasant (Shalom et al., 2006). Some PAMQ adjectives, such as "quiet" or "serious" may be considered neutral or more positive than negative for some adolescents. Cronbach's alphas for all domains were lower for COM adolescents than for those with HFA. This finding suggests that COM adolescents may view the sets of adjectives that we defined as either positive or negative as falling into more than two distinct categories. For these adolescents, trait adjectives may break down into different aspects of personality or behavior that they perceive during an interaction.

In examination of mean raw perception and metaperception scores, both HFA and COM adolescents reported liking their peers more than they reported disliking them. This is consistent with previous research on children's sociometric nominations of their peers (Hughes & Im, 2016). However, most research examining individuals' ratings of liking and disliking focuses on ratings of and by typically developing individuals and their familiar peers, particularly within the classroom setting. One of the few studies involving children with disabilities found that within the classroom setting, children and young adolescents with learning disabilities were less accepted by their peers than those without learning disabilities (La Greca & Stone, 1990). Another study investigating peer ratings of boys during a summer camp found that those with ADHD were more accepting of others with ADHD than those without a diagnosis (Hinshaw & Melnick, 1995). The five-minute interaction paradigm used in this study undoubtedly provides a limited experience with the peer, in contrast to classroom ratings where individuals are able to draw from extensive experience with and exposure to peers. However, these initial moments of a

social interaction provide important information about adolescents' first impressions, which may be critical for later formation of peer relationships and friendships (Hall & Andrzejewski, 2008).

In previous studies, children and young adolescents with learning disabilities predicted lower acceptance ratings from their classmates than did those without learning disabilities (La Greca & Stone, 1990). In contrast, in this study, all adolescents predicted higher mean liking ratings from peers than dislike ratings, providing evidence of the positivity bias, the bias toward attributing positive characteristics to oneself (Zhang, Guan, Qi, & Yang, 2013). Still, examination of the range of adolescents' positive metaperception scores demonstrates that some adolescents with HFA believed their peers did not like them very much. This may relate to low self-esteem self-reported in adolescents with HFA (Williamson, Craig, & Slinger, 2008), and supports the investigation of individual differences in metaperception that were examined in this study.

Social Metaperception and Theory of Mind

Social metaperception and theory of mind are theoretically linked, as social metaperception abilities require theory of mind; to pick up on a social partner's impressions, one must first be able to recognize that the social partner has independent thoughts. There is evidence that theory of mind and metaperception abilities recruit similar brain regions, further suggesting associations between the two skills (Ochsner et al., 2005). However, Ochsner and colleagues discuss the possibility that different types of metaperceptions ("reflected appraisals") may recruit different neural regions.

Interestingly, social metaperception accuracy was not related to theory of mind for adolescents with or without HFA in this study.

HFA and COM adolescents performed comparably on both theory of mind tasks. Previous research has demonstrated that individuals with HFA who have comparable verbal abilities to their typically developing peers can pass theory of mind tasks (Fisher, Happé, & Dunn, 2005; Happe, 1995), with adolescents outperforming children (Scheeren et al., 2013). Thus, comparable performance between HFA and COM participants in this study, where we used verbal IQ > 70 as inclusion criteria, is not unprecedented. However, the PAMQ may differentiate diagnostic groups in a way that standard theory of mind tasks do not. Previous work has suggested that there are complex nuances of everyday social interactions that are not assessed by static theory of mind tasks (Scheeren et al., 2013), and the PAMQ may be capturing some of these more advanced abilities.

Social Metaperception Accuracy

The APIMs conducted in Aim 2 were used to model accuracy of metaperception in terms of the effects of each adolescent's perception of the peer *and* the peer's actual perception on the adolescent's own metaperception. The APIM is particularly well-suited to this examination of dyadic associations because it takes into account variability both within and between dyads (Cook & Kenny, 2005). Findings indicate that adolescents with and without HFA are generally not accurate in their metaperceptions. Instead, their metaperceptions are associated with their views of their peers (i.e., significant actor, but not partner, effects). For all adolescents, the more they liked their peers, the more they believed they were liked. Similarly, for all adolescents, the more they disliked their peers, the more they believed they were disliked. This suggests that adolescents may rely on

their own views to determine what others may be thinking, perhaps following an "if I like you, then you must like me" logic. While this strategy can be useful in some contexts, during adolescence when peer social contexts become increasingly more complex and more salient, difficulties in differentiating between one's own perspective and the perspectives of others can worsen social difficulties. It is also plausible that the direction of effects is the other way, with metaperceptions guiding perceptions. Adolescents may form judgments of whether they are liked or not by peers, and subsequently use those judgments to decide whether they in turn like or dislike their peers.

For positively-valenced adjectives, or ratings of liking, the only evidence for metaperception accuracy was for adolescents with HFA, whose metaperceptions were marginally associated with peers' ratings of liking. This suggests that during live social interactions, adolescents with HFA detected social partners' cues and formed ideas about how they were being perceived. This finding was surprising and contrary to hypotheses, as previous research has indicated that individuals with HFA have significant problems understanding social cues such as eye contact from peers (Dratsch et al., 2013), and taking the perspectives of others (Shamay-Tsoory, 2008). However, some previous research has demonstrated that older adolescents and adults with HFA successfully detect changes in eye gaze (Fletcher-Watson, Leekam, Findlay, & Stanton, 2008) and other nonverbal social cues (Schwartz, Dratsch, Vogeley, & Bente, 2014), as well as verbal social cues (Foxe et al., 2015) in social scenes, video, or audio as well as typically developing peers. New and colleagues (2010) suggest that individuals with ASD may be able to *detect* social cues, but may not *attend* to these cues during real-world dynamic social interactions. Furthermore, the authors of these studies discuss the possibility that

studying these constructs in samples with adolescents or adults (and not children) with HFA who have average to high IQs (and not individuals with lower IQs) may partially explain findings. The sample of adolescents with HFA in this study is a very highly functioning group that does not necessarily generalize to other individuals with ASD, or even the larger population of those with HFA. This finding must also be interpreted with caution and replicated in a larger sample, as it did not reach significance.

In contrast, for COM adolescents, peers' ratings of liking were unrelated to individuals' metaperceptions. One hypothesized reason for the lack of association between the HFA peers' perceptions and the COM adolescents' metaperceptions is that the cues displayed by the adolescents with HFA may have been difficult for COM adolescents to interpret. In previous research, although adolescents with HFA did not differ from typically developing peers in the quantity of gestures made during a conversation, the synchrony of gestures with verbal communication was significantly lower in the HFA group (de Marchena & Eigsti, 2010; Morett, O'Hearn, Luna, & Ghuman, 2016). The authors suggested that while gestures used by typically developing adolescents may improve the quality of their verbal communication, this is not true for those with HFA. Perhaps this lack of synchrony and communicative quality in adolescents with HFA limits the ability of typically developing adolescents to discern social cues. This potential explanation for the lack of metaperception accuracy in the COM group could be further examined in studies of dyads including two COM individuals interacting together, to discern whether they are better able to interpret social cues in that context.

Associations of Social Metaperception with Social Competence

Surprisingly, social metaperception *accuracy* was not significantly associated with either observed Social Reciprocity or Social Initiative. Metaperception accuracy was predicted to be associated with observed social competence because it was thought to serve as an index of each person's skills in noticing and acknowledging social cues, and adapting behavior in response to cues during a live interaction. In this study, a discrepancy score was used to index metaperception accuracy, and outcome measures of social competence were coded at the individual level. Observed social competence thus reflected individual characteristics versus characteristics about the dyad. It is possible that the discrepancy may relate meaningfully to a dyad-level variable like rapport.

In a study relating metaperception accuracy to self-reported loneliness in adults, Kashy and colleagues (Christensen & Kashy, 1998) found that individuals who overestimated dislike from peers also reported more loneliness. Furthermore, these same individuals were not rated as disliked by their peers. In the same adolescent sample utilized in the current study, similar findings revealed that adolescents who overestimated dislike from peers during the laboratory social interaction reported more loneliness in the classroom, while those underestimating dislike reported low loneliness (Usher, Burrows, & Henderson, 2015). Interestingly, adolescents with HFA in the current study were not rated by their peers as being significantly more disliked or less liked than were COM adolescents. Metaperception accuracy may relate to perceptions of loneliness because measurement of both constructs focus on an individual's *perceptions* of interpersonal satisfaction. Relating metaperception accuracy to individual's self-reported social

competence or self-efficacy during an interaction would provide more information on how social metaperception abilities relate to other salient constructs.

Associations of Perceptions and Metaperceptions with Social Competence

Exploratory analyses revealed that there were unique effects of raw perceptions and metaperceptions on observed social competence that were not captured in the analyses using discrepancy scores. Raw perception and metaperception scores may capture aspects of an individual's worldview (perceptions) and self-esteem (metaperceptions), versus the accuracy of metaperceptions captured by the discrepancy. Individuals' perceptions of their peers' behavior and their beliefs of how they are perceived by peers may index traits similar to loneliness.

For all adolescents, predictions of more liking and less disliking from peers, as well as being rated as more liked by peers, were associated with displaying more Social Reciprocity. For Social Initiative, associations were similar. For all adolescents, predictions of higher liking from peers and being rated as less disliked by peers were associated with displaying more Social Initiative. This indicates that the way that an adolescent believes he/she is perceived as well as the way that he/she is actually perceived are both important factors relating to social competence, with directionality potentially going either way. This has been investigated during adolescence, where ratings of liking from peers has been found to be concurrently associated with observed social competence in a summer camp setting (Englund, Levy, Hyson, & Sroufe, 2000). Adolescents who have positive beliefs about how they are perceived by peers may subsequently have more reciprocal social interactions. Conversely, adolescents who have these reciprocal social interactions with peers may develop positive ideas of how they are

perceived by peers. Ratings of preschool children's sociometric standings in the classroom have shown that children who are rated by other children as most liked in earlier years display higher levels of observed social competence in the classroom by age five than children earlier rated as disliked by others (Santos, Vaughn, Peceguina, & Daniel, 2014). The directionality of effects involving perceptions, metaperceptions, and social competence should be further investigated in future longitudinal studies.

It is important to note that in this study, analyses were conducted using perceptions, metaperceptions, and metaperception accuracy as *predictors* of observed social competence. This is consistent with previous research demonstrating that an expectation of being liked by peers can lead to an increase in socially competent behavior (Parker et al., 2006). However, the model could potentially be flipped so that Social Reciprocity and Social Initiative are conceptualized as predictors of adolescents' perceptions, metaperceptions, and metaperception accuracy. Because adolescents completed the PAMQ after the social interaction, it is plausible that their behavior and the behavior of the peer may have acted as an influence on their PAMQ ratings. Future investigations of the relations between social metaperception and social competence should take directionality into consideration. It would be informative to obtain perception and metaperception ratings from the PAMQ in one setting, and to later relate them to outcomes in a different setting to assess whether these abilities generalize across contexts and over time.

Strengths and Limitations

This study had several strengths, including its design and utilization of a novel measure of perception and social metaperception to index these abilities in adolescents

with and without HFA. In addition, the unstructured peer interaction protocol provided a salient context upon which adolescents were able to base their initial impressions of peers who they had not met before. Finally, the APIM analyses provide unique perspectives on bidirectional influences during the dyadic interactions between unfamiliar adolescents.

One weakness of the study is its relatively small sample size, with 25 participants in each diagnostic group. Future research would benefit not only from incorporating a larger number of participants in each group, but also from including different types of dyads. For example, comparing dyads in which both participants have HFA, other dyads in which both participants are typically developing, and mixed dyads like those in this study, would allow for a contrast between the ways that adolescents with and without HFA interact with both typically and atypically developing peers. Additionally, we created dyads by matching adolescents on gender, age, and verbal IQ. However, adolescents are often not interacting with people of the same age and verbal IQ level. It would be informative to investigate whether individuals with HFA are able to form more accurate metaperceptions when interacting with younger or older individuals, or whether they are more or less accurate when interacting with other adolescents with HFA. Likewise, typically developing adolescents may be more concordant with peers' perceptions when interaction with other typically developing adolescents.

Our 5-minute social interaction was meant to index social behaviors that adolescents displayed to begin and maintain a social interaction with an unfamiliar peer. A longer interaction may provide more information for adolescents to consider, which may benefit them in formulating perceptions and metaperceptions of peers. It is worth noting, however, that many opinions are formed within the first moments of a social

interaction (Rim, Min, Uleman, Chartrand, & Carlston, 2013). Further, we found empirical support that adolescents were able to form impressions of their peers and metaperceptions, as all adolescents' responses exhibited good reliability.

Future studies may benefit from different social interaction paradigms in addition to the dyadic paradigms used in this study. For example, a round robin design in which all individuals in a group interact with all other individuals allows for the examination of general impressions, versus the unique impressions in dyadic interactions (as in this study). Round robin designs have not yet been used to examine perceptions and metaperceptions in individuals with ASD.

Future Directions

In this study, the analysis of SDSs in Aims 1 and 3 quantified congruence/discrepancy between one individual's metaperceptions and the peer's perceptions. However, recent developments in statistical analyses of informant discrepancies have indicated that, for optimal interpretation of congruence and discrepancy between raters (and the association of congruence/discrepancy and outcome variables), multiple types of analyses should be utilized and interpretations should be consistent (Laird & Weems, 2011). This is because SDSs are derived from individual informants' scores but do not account for mean values of either informant. Thus, models used to examine the same associations will provide different estimates of coefficients based on whether predictors are individual scores versus SDSs. Additionally, analyses using SDSs may provide coefficients that are not in the same direction as coefficients for individual scores, because of the fact that SDSs are always calculated with one informant's score minus the other's. Analyses using SDSs should be examined along

with other types of analyses, such as those examining the individual contributions of each informant's scores, and/or analyses examining quadratic effects of each informant's report. Laird and Weems present an empirical examination to demonstrate that analyses using SDSs and those using individual scores from each of two informants are mathematically equivalent. The authors suggest that when SDSs alone are used to understand agreement and discrepancy, interpretation is sometimes inconsistent with the mathematically equivalent two-informant model. They suggest that the optimal approach may be to conduct both types of analyses and present interpretation that is consistent with both.

Interaction terms within polynomial regression analyses can also be used to model informant discrepancy and congruence, and may aid in the interpretation of informant discrepancy findings obtained when utilizing difference scores (Laird & De Los Reyes, 2013). In this analytic approach, significant interactions can be probed to understand patterns of congruence versus discrepancy, such as differences between dyads in which one adolescent reports high scores and the other reports low scores, versus dyads in agreement, where both individuals report high or both report low scores. This approach controls for the main effects of each individual's scores on outcome variables, isolating the effect of the discrepancy from the individual effects on examined variables. Importantly, in this analysis, quadratic effects are also included in the model to examine whether associations between predictors and outcomes differ at different levels of congruence/discrepancy.

In addition to recommended complementary analyses, there are different ways that congruence/discrepancy may be conceptualized. One alternative is to examine

discrepancies on smaller sets of adjectives, instead of standardizing and averaging across the entire set of adjectives designated in this study as positive or negative. The examination of reliability of adolescents' responses, particularly in the COM sample, suggests that adolescents did not consistently view adjectives designated as positive or as negative in the same way. Typically developing adolescents may be thinking about adjectives in a nuanced way, seeing subsets within the larger group of adjectives. Examining discrepancy on smaller sets of adjectives may allow for a more refined understanding of individuals' perceptions and metaperceptions.

Finally, individual differences in metaperception accuracy examined within diagnostic group would potentially provide a better understanding of whether, within diagnostic groups, there are variables influencing metaperception abilities. The tendency to over- or underestimate liking or disliking from peers may be associated with variables such as autism symptoms, age, or IQ. Bivariate correlation analyses in this study revealed an inverse association between autism symptoms and social metaperception accuracy for dislike for adolescents with HFA. This suggests that adolescents with higher parent-reported lifetime autism symptoms underestimated dislike from peers, while those with low symptoms overestimated peers' dislike. Future work investigating the contribution of these individual difference variables may provide insight into whether autism symptoms, age, or IQ impact metaperception abilities.

Implications

Findings from this study have the potential to extend our existing understanding of typically and atypically developing adolescents' perceptions of peers and their dynamic abilities to discern what a social partner thinks of them. In order to form

metaperceptions, we use feedback from others in combination with self-perception and self-observation (Carlson & Kenny, 2012). Findings indicate that adolescents may rely more heavily on their own perspectives of others to form ideas of what others think of them. Furthermore, adolescents with HFA may be able to understand the ways that they are perceived by peers during social interactions more accurately than typically developing adolescents. This should be replicated in larger samples and explored in different contexts to gain insight into how individuals with HFA may be utilizing social cues to navigate social exchanges.

Research on social metaperceptions may inform existing interventions targeting social skills and social pragmatics in individuals with HFA, which are currently limited in their generalizability (see Williams White et al., 2007 for a review). Select feedback about accuracy of impressions may be helpful to better understand how one is viewed by others. In fact, previous studies have shown that metaperception is a trainable skill (Albright & Malloy, 1999), and some current interventions for individuals with HFA utilize video feedback of social interactions in order to provide individuals with perspective on the way they are viewed by others (Deitchman, Reeve, Reeve, & Progar, 2010). Others have demonstrated that while video feedback provides modest improvements in social competence for adolescents with HFA, in vivo self-monitoring offers greater improvements (State & Kern, 2012). This method involves teaching individuals to differentiate appropriate and inappropriate behaviors, and to identify whether these behaviors were displayed in a designated time period (e.g., in the minute prior). Using information from the PAMQ could be helpful to increase the ecological validity and generalizability of these interventions. The PAMQ also has the potential to

be useful in the investigation of perception and social metaperception in other salient settings, such as in the classroom or the workplace. Future work is needed to investigate how perceptions and metaperceptions change throughout development and across various settings.

Table 1. *Sample characteristics.*

	Diagnostic Group				Differences within dyads		Group differences	
	HFA		COM					
	Mean (SD)	*Range*	*Mean (SD)*	*Range*	*t* value	Cohen's *d*	*F* value	Cohen's *d*
Gender	17 M, 8 F	-	17 M, 8 F	-	-		-	
Age, years	14.66 (1.43)	12.13-17.67	14.21 (1.34)	12.05-16.71	3.30**	.94	1.33	.11
Verbal IQ	105.00 (14.79)	77-134	108.48 (13.83)	71-128	-1.32	-.38	.74	.25
ADOS	12.00 (4.22)	7-20	-	-	-		-	
SCQ	19.53 (7.47)	4-29	4.40 (3.49)	0-11	10.30***	2.94	82.39***	2.62
ASSQ	21.67 (8.62)	5-35	3.44 (3.18)	0-10	10.74***	3.10	98.07***	2.89

Note. HFA = high functioning autism, COM = comparison without autism, ADOS = Autism Diagnostic Observation Schedule, SCQ = Social Communication Questionnaire, ASSQ = Autism Spectrum Screening Questionnaire. Differences within dyads refer to paired-samples analyses.

* $p < .05$. $p < .01$. *** $p < .001$.

Table 2. *Abbreviated version of the Get to Know You Task*. Each participant in a dyad receives codes for every item.

Get to Know You Task: 5 minutes

1. Record total time talking and total length of task time to compute **proportion of time talking**.
2. Record **latency to first utterance** from start time.
3. Record **latency to first spontaneous utterance** from start time. A spontaneous utterance is an utterance that is not a response to a seek and/or initiates a new idea or topic.
4. Code each utterance as one of the following:
    a. **Share**, e.g., *"I used to be in the football team at my last school."*
    b. **Seek**, e.g., *"Have you seen Mortal Combat?"*
5. Rate **eye contact** on 5-point scale, based on flexibility and coordination with verbal communication (1=not coordinated with other communication, 5=well-coordinated with other communication).
6. Rate **conversational efficacy** on 5-point scale, based on social pragmatics, including taking turns, answering and asking questions, and not revealing overly friendly information (1=conversational skills rarely maintain flow of interaction, 5=conversational skills maintain flow of interaction).
7. Rate **social ease** on 5-point scale, based on behaviors indicate comfort versus discomfort during the interaction (1=Appears uncomfortable during social interaction; displays anxious behavior most of the time; little to no spontaneous affect , 5=Displays comfort during social interaction, including flexible affect and no anxious behaviors).

Table 3. *Descriptive statistics for primary measures of interest.*

	HFA				COM					
Measure Name	*n*	*M*	*SD*	*Range*	*n*	*M*	*SD*	*Range*	*F*-value	Cohen's *d*
Theory of Mind										
Strange Stories	22	20.50	3.00	14-24	22	21.36	2.17	15-24	1.19	.34
Reading the Mind in the Eyes	24	19.08	3.54	12-24	25	20.04	2.61	14-26	1.17	.32
Observed Social Reciprocity	25	-0.31	0.84	-1.91-1.62	25	0.31	0.55	-1.04-1.29	9.59**	.89
Seeking	25	7.72	6.55	0-27.50	25	10.12	5.25	1.5-22.0	2.04	.41
Eye Contact	25	3.46	1.25	1-5	25	4.20	0.80	2.5-5.0	6.20*	.72
Conversational Efficacy	25	3.42	0.90	1.5-5	25	4.16	0.77	2-5	9.75**	.90
Social Ease	25	3.68	1.24	1-5	25	4.30	0.58	3-5	5.13*	.65
Observed Social Initiative	25	-0.03	0.56	-1.11-1.11	25	0.03	0.79	-2.06-1.14	.11	.10
Proportion of Time Talking	25	0.30	0.13	0.09-0.56	25	0.23	0.10	0.06-0.49	4.03†	.58
Latency to First Utterance	25	3.14	4.95	0-26	25	2.04	1.38	0-6	1.15	.31
Latency to First Spontaneous Utterance	25	16.76	35.90	0-179	25	8.88	17.40	0-64.50	.98	.29
Sharing	25	25.34	8.56	7-38	25	22.68	10.18	2-39	1.00	.29
Perceptions (Raw)										
Positively-Valenced Adjectives	24	45.50	10.27	31-65	25	44.12	8.56	29-65	.26	.15
Negatively-Valenced Adjectives	22	20.50	5.88	12-32	24	21.79	5.38	14-33	.61	.24
Metaperceptions (Raw)										
Positively-Valenced Adjectives	24	41.67	12.27	17-64	25	44.44	9.36	24-61	.80	.26
Negatively-Valenced Adjectives	24	23.75	7.31	12-40	24	21.75	6.58	13-47	.99	.29

Table 3, continued

Social Metaperception Accuracy (SDS)										
Positively-Valenced Adjectives	24	-.06	.98	-1.89-1.58	24	.07	1.30	-1.74-2.66	.14	.11
Negatively-Valenced Adjectives	24	.03	1.27	-2.62-2.15	22	-.05	1.44	-2.62-3.70	.05	.07

Note. HFA = high functioning autism, COM = comparison without autism, SDS = standardized difference score.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$

Table 4. *Correlations between primary variables and age, autism spectrum disorder (ASD) symptoms, and verbal IQ for group with high functioning autism.*

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. ASD symptoms	-.35†	-											
3. Verbal IQ	-.07	-.04	-										
4. Reading the Mind in the Eyes	.24	.15	.50*	-									
5. Strange Stories	.14	-.16	.11	.04	-								
6. Social Reciprocity composite	.19	-.16	-.27	-.20	-.03	-							
7. Social Initiative composite	.20	.12	-26	-.32	-.17	.55**	-						
8. Positive Perceptions	.02	.21	.01	-.30	-.20	.37†	-.15	-					
9. Negative Perceptions	-.01	-.11	-.14	-.03	.11	-.42†	-.14	-.66**	-				
10. Positive Metaperceptions	.05	.22	-.18	-.32	-.30	.60**	-.22	.62**	-.38†	-			
11. Negative Metaperceptions	.08	-.28	.18	.12	.25	-.40†	.18	-.41*	.70**	-.59**	-		
12. Social Metaperception Accuracy (SDS) – Positively Valenced	-.17	.32	-.02	-.25	-.31	.21	-.26	.29	-.22	.62**	-.44*	-	
13. Social Metaperception Accuracy (SDS) – Negatively Valenced	.29	-.41*	-.11	-.04	.18	-.12	.18	-.49*	.49*	-.18	.67**	-.49*	-

Note. SDS = standardized difference score.

† $p < .10$. * $p < .05$. ** $p < .01$.

Table 5. *Correlations between primary variables and age, autism spectrum disorder (ASD) symptoms, and verbal IQ for comparison group.*

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. ASD symptoms	.01	-											
3. Verbal IQ	.17	.22	-										
4. Reading the Mind in the Eyes	.03	-.16	-.24	-									
5. Strange Stories	.24	.12	.34†	.20	-								
6. Social Reciprocity composite	.19	.19	.20	.43*	.50*	-							
7. Social Initiative composite	.24	.21	.54**	.26	.33	.20	-						
8. Positive Perceptions	.02	.21	.01	-.30	-.20	.37†	-.15	-					
9. Negative Perceptions	-.01	-.11	-.14	-.03	.11	-.42†	-.14	-.66**	-				
10. Positive Metaperceptions	.05	.22	-.18	-.32	-.30	.60**	-.22	.62**	-.38†	-			
11. Negative Metaperceptions	.08	-.28	.18	.12	.25	-.40†	.18	-.41*	.70**	-.59**	-		
12. Social Metaperception Accuracy (SDS) – Positively Valenced	.18	.03	-.03	.02	.05	.06	.19	.04	.09	.55**	-.33	-	
13. Social Metaperception Accuracy (SDS) – Negatively Valenced	-.33	-.27	.04	.05	.23	-.09	.10	-.09	.23	-.35	.69**	-.58**	-

Note. SDS = standardized difference score.

† $p < .10$. * $p < .05$. ** $p < .01$.

Table 6. *Eigenvalues and loadings for peer social competence composite variables PCA.*

	Eigenvalues	
	Social Reciprocity	**Social Initiative**
	4.00	1.65
	Loadings	
Coded Variables		
Proportion of Time Talking	.16	.85
Latency to First Utterance	.06	-.36
Latency to First Spontaneous Utterance	-.33	-.51
Sharing	.20	.83
Seeking	.68	-.05
Eye Contact	.73	.17
Conversational Efficacy	.81	.30
Social Ease	.82	.09

Note. Shaded loading values indicate variables that were included in each factor.

Table 7. *Actor-Partner Independence Models demonstrating associations of liking and disliking with metaperceptions of liking and disliking (Aim 2).*

	Outcome: Metaperception of Liking			
Liking	*b*	*β*	*t*(df)	*p*
Actor[a]	.66	.57	4.19(28)	<.001
Partner[b]	.17	.15	1.08(27)	.29
Actor*Group	-.10	-.09	-.76(41)	.45
Partner*Group	.32	.28	2.33(36)	.03
	Outcome: Metaperception of Disliking			
Disliking	*b*	*β*	*t*(df)	*p*
Actor[a]	.73	.59	4.40(31)	<.001
Partner[b]	.04	.03	.23(32)	.82
Actor*Group	.15	.12	.96(35)	.34
Partner*Group	.10	.08	.65(36)	.52

[a]Actor effects refer to a person's liking (top) or disliking (bottom) on his/her own metaperception of liking (top) or metaperception of disliking (bottom).

[b]Partner effects refer to a person's partner's liking (top) or disliking (bottom) on the person's metaperception of liking (top) or metaperception of disliking (bottom).

Table 8. *Actor-Partner Independence Models demonstrating nonsignificant actor and partner effects of metaperception accuracy of liking and disliking with Social Reciprocity (Aim 3).*

Outcome: Social Reciprocity				
Metaperception Accuracy of Liking	*b*	*β*	*t*(df)	*p*
Actor[a]	.06	.09	.44(24)	.66
Partner[b]	-.01	-.02	-.09(26)	.93
Actor*Group	.03	.04	.25(27)	.80
Partner*Group	.03	.05	.33(39)	.74
Metaperception Accuracy of Disliking	*b*	*β*	*t*(df)	*p*
Actor[a]	-.04	-.07	-.30(21)	.77
Partner[b]	.02	.03	.14(22)	.89
Actor*Group	.02	.03	.16(27)	.87
Partner*Group	.04	.07	.40(30)	.70

[a]Actor effects refer to a person's metaperception accuracy of liking (top) or metaperception accuracy of disliking (bottom) on his/her own Social Reciprocity.

[b]Partner effects refer to a person's partner's metaperception accuracy of liking (top) or metaperception accuracy of disliking (bottom) on the person's Social Reciprocity.

Table 9. *Actor-Partner Independence Models demonstrating nonsignificant actor and partner effects of metaperception accuracy of liking and disliking with Social Initiative (Aim 3).*

	Outcome: Social Initiative			
Metaperception Accuracy of Liking	*b*	*β*	*t*(df)	*p*
Actor[a]	.05	.08	.37(26)	.72
Partner[b]	.02	.04	.20(31)	.84
Actor*Group	-.11	-.18	-.90(26)	.38
Partner*Group	-.11	-.18	-.99(31)	.33
Metaperception Accuracy of Disliking	*b*	*β*	*t*(df)	*p*
Actor[a]	-.002	-.003	-.01(23)	.99
Partner[b]	-.10	-.19	-.92(24)	.36
Actor*Group	-.03	-.05	-.24(24)	.81
Partner*Group	-.08	-.16	-.83(25)	.42

[a]Actor effects refer to a person's metaperception accuracy of liking (top) or metaperception accuracy of disliking (bottom) on his/her own Social Initiative.

[b]Partner effects refer to a person's partner's metaperception accuracy of liking (top) or metaperception accuracy of disliking (bottom) on the person's Social Initiative.

Table 10. *Actor-Partner Independence Models demonstrating significant effects of metaperceptions of liking and disliking on Social Reciprocity for all adolescents (Aim 3 - Exploratory).*

	Outcome: Social Reciprocity			
Liking	*b*	*β*	*t*(df)	*p*
Actor Metaperception[a]	.03	.37	3.13(33)	<.01
Partner Perception[b]	.02	.24	1.77(32)	.09
Actor Metaperception *Group	.01	.08	.63(39)	.53
Partner Perception*Group	.01	.09	.64(32)	.53
Disliking	*b*	*β*	*t*(df)	*p*
Actor Metaperception[a]	-.03	-.30	-2.40(34)	.02
Partner Perception[b]	-.03	-.18	-1.39(35)	.17
Actor Metaperception *Group	-.01	-.09	-.71(38)	.48
Partner Perception*Group	-.01	-.08	-.64(36)	.53

[a]Actor effects refer to a person's *metaperception* of liking (top) or *metaperception* of disliking (bottom) on his/her own Social Reciprocity.

[b]Partner effects refer to a person's partner's *perception* of liking (top) or *perception* of disliking (bottom) on the person's Social Reciprocity.

Table 11. *Actor-Partner Independence Models demonstrating significant effects of metaperception of liking on Social Initiative, and significant effects of partner's disliking on Social Initiative (Aim 3 - Exploratory).*

	Outcome: Social Initiative			
Liking	*b*	*β*	*t*(df)	*p*
Actor Metaperception[a]	.03	.43	3.09(37)	<.01
Partner Perception[b]	.02	.23	1.60(33)	.12
Actor Metaperception*Group	-.00	-.00	-.004(34)	.99
Partner Perception*Group	.01	.16	1.14(33)	.26
Disliking	*b*	*β*	*t*(df)	*p*
Actor Metaperception[a]	-.01	-.15	-1.18(35)	.25
Partner Perception[b]	-.05	-.41	-3.02(36)	<.01
Actor Metaperception*Group	.01	-.13	-.92(38)	.36
Partner Perception*Group	-.03	-.21	-1.53(37)	.14

[a]Actor effects refer to a person's *metaperception* of liking (top) or *metaperception* of disliking (bottom) on his/her own Social Initiative.

[b]Partner effects refer to a person's partner's *perception* of liking (top) or *perception* of disliking (bottom) on the person's Social Initiative.

Figure 1. *Perception and metaperception*. The boy has perceptions of his social partner. The girl has metaperceptions, or perceptions of what the boy thinks about her.

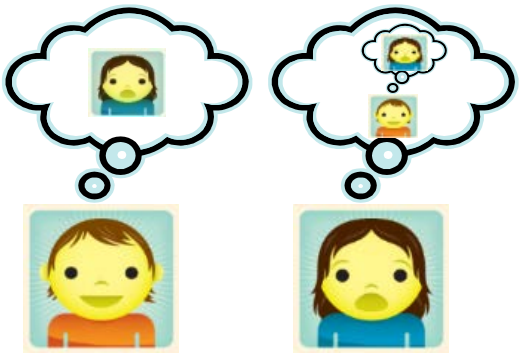
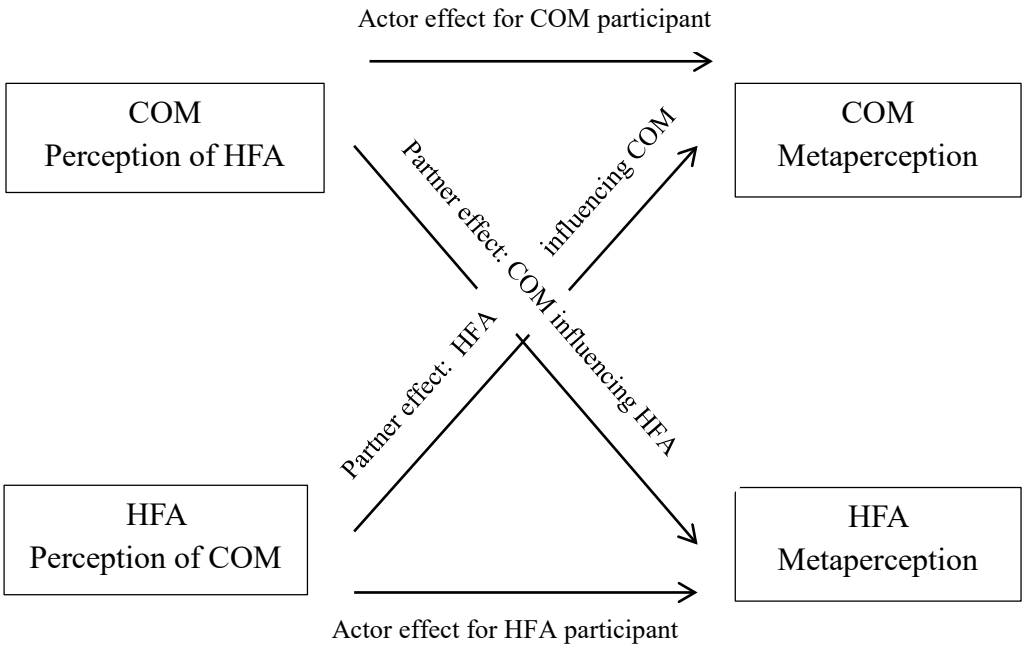
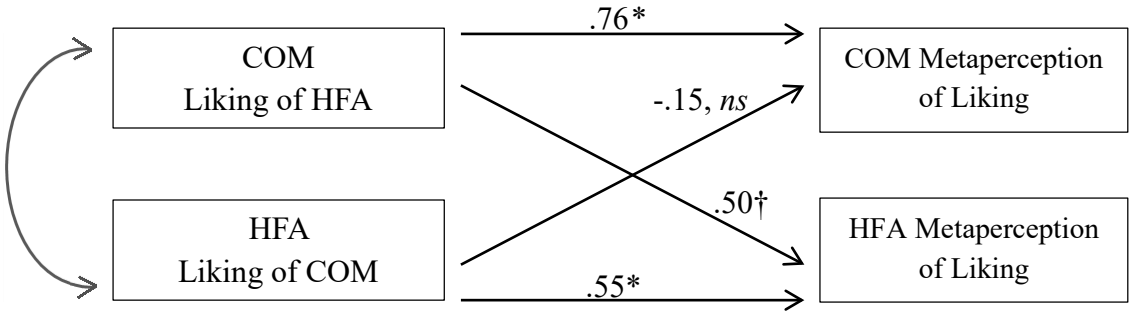


Figure 2. *Actor-Partner Interdependence Model (APIM).* Horizontal associations illustrate actor effects, where a person's perception of the peer has an effect on the person's own metaperception. Diagonal associations illustrate partner effects, where a person's partner's perception of him/her has an effect on the person's metaperception.



Note. HFA = high functioning autism, COM = comparison

Figure 3. *Actor-partner interdependence model (APIM) illustrating dyadic perception and metaperception for positively-valenced adjectives in unfamiliar dyad members (Aim 2).* For COM adolescents, one's liking of the peer has a stronger effect on metaperceptions (horizontal association) than does the partner's liking rating (diagonal association). For adolescents with HFA, associations are similar, although the partner's liking has a trend-level effect on metaperceptions (diagonal association).



Note. * $p < .05$, † $p < .10$, *ns* non-significant. HFA = high functioning autism, COM = comparison

Appendix. *Perception and Metaperception Questionnaire.* Items containing positively-valenced adjectives have been marked * for this paper, but are not marked on the administered questionnaire.

Please answer the following questions about the person you just interacted with using the following scale:

1 = *not at all* 2 = *a little* 3 = *in the middle* 4 = *a lot* 5 =*the most*

1. How happy is _____? * 1—2—3—4—5
2. How outgoing is _____? * 1—2—3—4—5
3. How relaxed is _____? * 1—2—3—4—5
4. How talkative is _____? * 1—2—3—4—5
5. How boring is _____? 1—2—3—4—5
6. How insecure is _____? 1—2—3—4—5
7. How positive is _____? * 1—2—3—4—5
8. How quiet is _____? 1—2—3—4—5
9. How anxious or nervous is _____? 1—2—3—4—5
10. How negative is _____? 1—2—3—4—5
11. How unhappy is _____? 1—2—3—4—5
12. How cool is _____? * 1—2—3—4—5
13. How polite is _____? * 1—2—3—4—5
14. How mature is _____? * 1—2—3—4—5
15. How annoying is _____? 1—2—3—4—5
16. How funny is _____? * 1—2—3—4—5
17. How uncool is _____? 1—2—3—4—5
18. How shy is _____? 1—2—3—4—5
19. How serious is _____? 1—2—3—4—5
20. How immature is _____? 1—2—3—4—5
21. How helpful is _____? * 1—2—3—4—5
22. How confident is _____? * 1—2—3—4—5
23. How exciting is _____? * 1—2—3—4—5
24. How impolite is _____? 1—2—3—4—5
25. How entertaining is _____? * 1—2—3—4—5

Please answer the following questions about the person you just interacted with using the following scale:

1 = *not at all* 2 = *a little* 3 = *in the middle* 4 = *a lot* 5 =*the most*

26. How uncool does _____ think you are?	1——2——3——4——5
27. How outgoing does _____ think you are? *	1——2——3——4——5
28. How negative does _____ think you are?	1——2——3——4——5
29. How boring does _____ think you are?	1——2——3——4——5
30. How anxious or nervous does _____ think you are?	1——2——3——4——5
31. How relaxed does _____ think you are? *	1——2——3——4——5
32. How funny does _____ think you are? *	1——2——3——4——5
33. How talkative does _____think you are? *	1——2——3——4——5
34. How immature does _____think you are?	1——2——3——4——5
35. How cool does _____ think you are? *	1——2——3——4——5
36. How positive does _____ think you are? *	1——2——3——4——5
37. How happy does _____ think you are? *	1——2——3——4——5
38. How polite does _____think you are? *	1——2——3——4——5
39. How quiet does _____think you are?	1——2——3——4——5
40. How annoying does_____ think you are?	1——2——3——4——5
41. How shy does _____think you are?	1——2——3——4——5
42. How impolite does _____think you are?	1——2——3——4——5
43. How mature does _____think you are? *	1——2——3——4——5
44. How entertaining does _____think you are? *	1——2——3——4——5
45. How serious does _____ think you are?	1——2——3——4——5
46. How helpful does _____think you are? *	1——2——3——4——5
47. How confident does _____think you are? *	1——2——3——4——5
48. How exciting does _____think you are? *	1——2——3——4——5
49. How unhappy does _____ think you are?	1——2——3——4——5
50. How insecure does _____think you are?	1——2——3——4——5
51. How well did your interaction with _____ go overall?	1——2——3——4——5
52. How much would you want to continue a friendship with _____ outside of the lab?	1——2——3——4——5

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