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Predicting Variation in Social Outcome among Adolescents with High-Functioning Autism

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UNIVERSITY OF MIAMI

PREDICTING VARIATION IN SOCIAL OUTCOME AMONG ADOLESCENTS
WITH HIGH-FUNCTIONING AUTISM

By

Caley Bryce Schwartz

A DISSERTATION

Submitted to the Faculty
of the University of Miami
in partial fulfillment of the requirements for
the degree of Doctor of Philosophy

Coral Gables, Florida

June 2009

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WITH HIGH-FUNCTIONING AUTISM

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Even among the most high-functioning individuals with autism, there is a wide range of variation in outcome. This study examined within-child factors, such as temperament, that contribute to variation in social outcomes, the most salient area of deficit among individuals with high-functioning autism (HFA). Approach/withdrawal tendencies and effortful control were used to predict variation in symptoms and social skills. A unique multi-method approach employing self- and parent-report measures, physiological assessment, and social observation was used to determine whether temperament could be used to predict variation in social skills and symptom presentation. Results indicated that compared with an age- and gender-matched control group, the HFA group self-reported higher levels of negative affect and lower levels of surgency and were observed to exhibit higher levels of approach tendencies and lower levels of social skills. Across all participants, higher levels of effortful control were predictive of more adaptive social skills and higher levels of observed approach behavior were predictive of higher levels of anxiety. These results are discussed in relation to the variability in outcomes seen among individuals with autism and the implications for the development of interventions to enhance adaptive outcomes.

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Chapter 1: Introduction

The symptom profile of individuals with autism is partially characterized by deficits in social skills and as a result these individuals have difficulty developing friendships and report feelings of loneliness and dissatisfaction with interpersonal relationships (Travis & Sigman, 1998). Learning how to appropriately engage in peer interactions is a challenge for all children and adolescents over the course of their development (Rubin, Bukowski, & Parker, 1998). Children learn social skills by watching and interacting with their peers, and peers provide positive and negative feedback to shape each other's behavior to reflect cultural social norms (Bandura & Walters, 1963; Rubin et al., 1998). Social behaviors are generally expressed or inhibited based on the previous consequences of the behavior in certain situations and with certain individuals (Rubin et al., 1998). Although there are many socialization factors that influence the development of social skills in children including their parents, peers, and school and home environments, there are also many individual differences within a child, such as temperament, that influence the development and expression of social skills.

Children with autism have been shown to exhibit more severe social deficits, not only in comparison with typically developing children, but also compared with individuals with other developmental disabilities, regardless of intellectual level (Guralnick, 1986; Guralnick & Groom, 1985; Guralnick & Weinhouse, 1984; Strain, 1984; Sigman & Ruskin, 1999). However, there is a great deal of variability in the social skills of individuals with autism, even among the most high-functioning individuals (McGovern & Sigman, 2005). Research has shown that although IQ has been related to

daily living skills and communication development, social skills development in individuals with autism is independent of IQ (Freeman, Del’Homme, Guthrie, & Zahang, 1999). Hence, this study set out to investigate another variable, temperament, to determine if it could help predict social development in individuals with autism, as it does in typically developing individuals (Sanson, Hemphill, & Smart, 2004; Rothbart & Bates, 1998; Seifer, 2000). Two aspects of temperament, approach/withdrawal and self-regulation, were examined as predictors of self-perceptions of friendships and observed social skills among typically developing adolescents and adolescents with high-functioning autism (HFA). A multi-method approach was employed, including self-report measures of temperament, perceptions of friendships, and social-emotional functioning, parent-report measures of symptom presentation, behavioral and physiological indices of self-regulation, and observations of social skills during an interaction with an unfamiliar peer, in order to begin to test a model of the contribution of temperament to social development among individuals with HFA.

Defining Social Skills

In order to be successful at developing and maintaining friendships, children must possess social skills, which are discrete behaviors that “...comprise thoughts, emotions, and the regulation there of, and observable behaviors” (Rubin et al., 1998, p. 645). There is a great deal of variability among children in the degree to which they possess and are able to flexibly implement social skills during interactions with others. Across all children, social skills vary by age and developmental level. For example, for children ages two to three, social skills entail imitative and parallel play, taking turns, helping, and

sharing, whereas social skills for children in preschool entail using language as a means of engaging in prosocial behaviors directed at peers (Rubin et al., 1998). Throughout childhood individual social skills become integrated so that an individual is able to coordinate their verbal and nonverbal behaviors in order to act appropriately in a variety of social situations with a variety of people (Spence, 2003). By late childhood, typically developing individuals have integrated their social skills into socially competent behavior, which is reflected in the achievement of peer acceptance and friendship, and these socially competent children tend to go on to become socially competent adolescents (Fogle, Huebner, & Laughlin, 2002; McNamara, Wigfield, & Wigfield, 2002). Additionally, in adolescence, the need for peer acceptance and high quality friendships, characterized by high levels of warmth and validation, increases (Rubin et al., 2004; Berndt, Hawkins, & Jiao, 1999; Booth, Rubin, & Rose-Krasnor, 1998; Fordham & Stevenson-Hinde, 1999; Ladd, Kochenderfer, & Coleman, 1996; Parker & Asher, 1993; Stocker, 1994).

Individuals with HFA exhibit difficulty forming friendships, which may reflect their difficulty acquiring social skills. Conversely, popular children, or children who are accepted by their peers, are generally those who have mastered and integrated a range of social skills (Rubin et al., 1998; Black & Hazen, 1990). As Rubin et al. (1998) stated, it is extremely difficult to identify all the social skills an individual who is successful in social interactions may possess, but they were able to generate a representative list of skills including: the ability to monitor one's own behavior in determining various ways to approach a peer to initiate, as well as maintain or end, a conversation or interaction; to be aware of situational demands in order to monitor one's thoughts about the results of

actions, not only for oneself, but also for one's peers; to monitor self-expression to ensure it is comprehensible to others verbally and nonverbally; to take another's perspective (i.e., think about what another child is thinking about; Jennings, 1975; Farver & Branstetter, 1994) and make an effort to understand and follow the requests of a peer; and to know when to express or inhibit positive and negative emotions or actions towards a peer.

Core social cognitive deficits that are seen in individuals with autism make it difficult for these individuals to develop social skills, resulting in decreased social competence and difficulty making and maintaining friendships. For example, research has shown that individuals with autism have difficulty developing a theory of mind, which makes it difficult to take another person's perspective (Baron-Cohen, 1991; Mundy, 2003). Without this ability, it is also difficult for individuals with autism to think about what another child is thinking, or to anticipate possible results of their actions for themselves and their peers. As a result, individuals with autism generally have difficulty regulating their social approach and avoidance motivation which can be seen beginning at a very young age. For example, Sigman and Ruskin (1999) compared children with autism between two and six years of age, to children with Down syndrome and typically developing children during unstructured play time at school. Results indicated that the children with autism made significantly fewer attempts to initiate interactions with peers and responded significantly less to initiations from peers, compared with the other groups. As individuals with autism develop, similar deficits are reflected, for example, in difficulty with conversational skills including initiating, maintaining, and ending a

conversation, and responding to an initiation by another individual (Capps, Kehres, & Sigman, 1998; Tager-Flusberg & Anderson, 1991).

Even among the most high-functioning individuals with autism, Sigman and Ruskin (1999) found that while they were more involved with peers overall, compared with lower functioning individuals, and some were able to sustain an interaction with a peer, they were likely to show deficits in appropriately ending a conversation, as they would abruptly break off an interaction and walk away. Travis and Sigman (1998) concluded that these conversational deficits may involve an inability to “monitor others’ mental states and the factors that influence them” (p. 66). This tendency to closely monitor one’s thoughts and behaviors with reference to contextual demands, and to infer another’s thoughts and behaviors may be related to regulatory aspects of temperament. Hence, it is surprising that although social self-monitoring has been hypothesized to be deficient in individuals with HFA, no direct assessment of the association between aspects of self-monitoring and actual social behaviors have been conducted.

Temperament as a Predictor of Social Skills

Temperament has been defined as “constitutionally based differences in behavioral style that are visible from the child’s earliest years” (Sanson et al., 2004, p.143). Temperament has been divided into two broad domains: reactivity and self-regulation (Rothbart & Derryberry, 1981, 2002; Rothbart 2003; Rothbart, Posner, & Hershey, 1995). Reactivity refers to individual differences in responsivity or arousability of behavioral and physiological systems, while self-regulation refers to processes that modulate this reactivity. In the current study, approach/withdrawal tendencies were used

to index reactivity, and response-monitoring and social self-monitoring were used as indices of self-regulation, because within a sample of children with HFA, these three dimensions have been theoretically related to the development of social skills, individual differences in symptom severity, and social and emotional adjustment (Sutton et al, 2005; Henderson et al., 2006; Schwartz et al., 2007).

These temperamental constructs apply to all individuals regardless of age, developmental level, or psychological diagnosis, and individuals with autism are no exception (Konstantareas & Stewart, 2006). Research has been conducted to examine group differences between individuals with autism and typically developing individuals on various dimensions of temperament, including approach/withdrawal and aspects of self-regulation. Some of the first concerns expressed by parents of children with autism include extremes of temperament including passivity and irritability (Zwaigenbaum et al., 2005). Kasari and Sigman (1997) found that autistic children were more likely to be rated by their parents as “difficult,” a profile reflecting increased emotional reactivity and decreased self-regulation, compared to typically developing children. Research has also shown that children with autism are rated by their parents as being more withdrawn than typically developing children (Bailey, Hatton, Mesibov, Ament, & Skinner, 2000), and young adolescents with HFA report more withdrawal tendencies and fewer approach tendencies than their typically developing peers (Schwartz et al., 2007).

Very little attention, however, has been directed at using temperament to predict individual differences in adaptive behavior among individuals with HFA, but studies have shown that aspects of temperament, including reactivity and self-regulation, predict

individual differences in social development and peer relationships in typically developing children (Sanson et al., 2004; Rothbart & Bates, 1998; Seifer, 2000).

Approach/Withdrawal

Perhaps the most important aspect of temperamental reactivity for social development is the approach-withdrawal dimension (Sanson et al., 2004). Children who exhibit high levels of temperamental approach tend to have more positive social relationships and are generally popular among their peers (Sanson et al., 2004; Rubin et al., 1998), while early temperamental inhibition has been associated with social withdrawal across childhood (Rubin et al., 1998).

Social withdrawal has been referred to as the tendency for children to play alone or watch their peers (Burgess, Rubin, Cheah, & Nelson, 2001), which may be the result of previous experiences with isolation or rejection by peers, a lack of necessary social skills to join ongoing interactions, or a lack of interest in social interaction. Socially withdrawn children are not outgoing and tend not to enjoy novel experiences, like their approach oriented peers (Kagan, 1997; Mendez, Fantuzzo, & Cicchetti, 2002). As a result, they have limited opportunities to practice their social skills (Rubin et al., 1998). While children who are high in approach motivation are likely to have both positive and negative experiences when interacting with peers, and therefore learn socially and culturally appropriate ways of interacting as a result of the feedback they receive, socially withdrawn children have fewer opportunities to practice their social skills, social problem solving skills, and their ability to resolve conflicts in appropriate ways (Diener & Kim, 2004). Even when peers are familiar to them (e.g., classmates), withdrawn children have

difficulty engaging in social interactions (Burgess et al., 2001). For these children, their previous lack of engagement in social interaction, due to their temperamental inhibition, may result in decreased social learning, which in turn, results in deficits in social skills (Burgess et al., 2001). On the other hand, individuals who are approach oriented are sensitive to rewards and, as a result, have a strong social motivation (Pavot, Diener, & Fujita, 1990; Fogle et al., 2002). Hence, they acquire social skills more easily than individuals who exhibit withdrawal tendencies, because the positive feedback they receive for the appropriate use of social skills is extremely reinforcing (Buss & Plomin, 1984; Fogle et al., 2002).

In addition to the direct effects of approach/withdrawal on the development of social skills, social self-perceptions may act as a mediating factor linking temperamental differences with social outcomes (Fogle et al., 2002), as self-perceptions have been correlated with an individuals' actual social competence, as reported by teachers and parents (Eccles, Wigfield, & Schiefele, 1998; Harter, 1998; Masten et al., 1995; McNamara et al., 2002). Positive self-perceptions, seen more often in individuals who are approach oriented, have been linked to assertiveness and feelings of confidence in engaging in social interactions (Fogle et al., 2002). On the other hand, individuals who self-report, or are reported by their teachers to exhibit withdrawal tendencies report more negative self-perceptions and less self-confidence regarding their social abilities and social acceptance (Fogle et al., 2002; Hymel, Rubin, Rowden, & LeMare, 1990; Rubin, Chen, & Hymel, 1993; McNamara et al., 2002).

Despite clear evidence in typical development that the approach-withdrawal dimension of temperament is a strong predictor of social skills, friendships, and social

self-perceptions, it is notable that few investigations to date have examined how individual differences in approach/withdrawal tendencies among individuals with autism may be used to explain variation in social outcomes in this population. Clinical experience would suggest that a wide range of individual temperaments exist among individuals with autism, even among the most high-functioning individuals. Psychophysiological indices of approach/withdrawal support these observations, as research has shown that cortical frontal EEG asymmetry, thought to index approach/withdrawal tendencies, is associated with variations in social motivation in typically and atypically developing individuals (Sutton & Davidson, 1997; Sutton, 2002; Sutton et al., 2005). In typically developing individuals, those with right frontal asymmetry tend to be more withdrawn while individuals with left frontal asymmetry tend to be more approach oriented (Davidson, 1998; Baving, Laucht, & Schmidt, 2002; Fox, 1991). Sutton et al. (2005) also demonstrated that individual differences in social and emotional symptoms among individuals with HFA were related to patterns of resting frontal EEG asymmetry. The results indicated that individuals with relative right frontal asymmetry self-reported more social impairments, while those with relative left frontal asymmetry self-reported less social impairment, but greater social anxiety and less satisfaction with interpersonal relationships. A much needed extension of this research is to employ direct observations of the behavior of individuals with HFA during an in vivo social interaction, in addition to self- or parent-report measures, in order to empirically examine the associations between these temperamental traits and observable social skills. This study began to address this area by examining if individual differences in approach/withdrawal tendencies, as assessed using self- and parent-report measures,

could be used to predict in vivo social behaviors during interactions with an unfamiliar peer, and whether these associations were partially mediated through self-perceptions of friendship quality for an individual with HFA.

Self-Regulation

The second aspect of temperament that was examined in the current study is effortful control, also referred to as self-regulation, which is the ability to “inhibit a dominant response in order to activate a subdominant response” (Rothbart, Ellis, Rueda, & Posner, 2003, p. 1114; Jones, Rothbart, & Posner, 2003). Effortful control has been described as an overarching temperament factor that allows for the regulation of reactivity and negative affect in order to enable individuals to behave in the most adaptive ways (Rothbart et al., 1995; Rothbart et al., 2003). High levels of effortful control are positively related to successful moral, behavioral, and social development in typically developing individuals (Rothbart et al., 2003). For example, in social interactions, effortful control allows an individual to inhibit a dominant or emotional response for a subdominant or more socially appropriate response (Rothbart et al., 2003).

For children with autism, self-regulatory deficits can be seen within the first two years of life, as deficits in imitation (Smith & Bryson, 1994), joint attention (Mundy et al., 1986), motor planning (Hughes, 1996), and error correction (Russell & Jarrold, 1998) become apparent. These deficits may be the result of an inability to monitor their behaviors and interactions with others, possibly due to structural and functional deficits in the medial prefrontal cortex and Anterior Cingulate Cortex (ACC), the structures underlying self-regulation (Mundy, 2003). Self-regulatory abilities have been shown to

differ both qualitatively and quantitatively in individuals with autism compared with individuals with Down syndrome and other forms of mental retardation, and those with typical development (Gomez & Baird, 2005; Konstantareas & Stewart, 2006). For example, results of one study in which parents rated their children's temperament, using the Children's Behavior Questionnaire (CBQ; Goldsmith & Rothbart, 1991), indicated that children with autism were significantly less proficient in attentional focusing and shifting, and inhibitory control, all of which are aspects of self-regulation, compared with their typically developing age and gender matched peers (Konstantareas & Stewart, 2006).

Response-monitoring may be a particularly important aspect of self-regulation for individuals with autism, according to several models of autism that postulate that deficits in executive functioning are central to the disorder (Mundy, 2003; Hill, 2004; Hughes, Russel, & Robbins, 1994; Ozonoff, 1997; Ozonoff et al., 2004; Ozonoff, Pennington, & Rogers, 1991; Ozonoff, South, & Provençal, 2005; Pennington & Ozonoff, 1996; Bogte, Flamma, van der Meere, & van Engeland, 2007). A study by Russell and Jarrold (1998) compared adolescents with autism, moderate learning disabilities, and typical development, on a task specifically assessing response-monitoring. All children were presented with a computer game in which they were required to press one of two buttons to respond to compatible and incompatible stimuli and to immediately correct their errors. Overall, children with autism made more errors and corrected a smaller proportion of their errors than the other groups, indicating that children with autism have a deficit in response-monitoring that negatively impacts their ability to flexibly alter their actions. A second study examining response-monitoring in individuals with HFA by Bogte et al.

(2007), reported on the performance of individuals with HFA and typically developing individuals on a memory recognition task. In this task there were two conditions, a baseline condition in which the two possible responses were equally likely and a response bias condition in which one response was three times as likely as the other. Results indicated that while the control group slowed their reaction time on trials following an error in the baseline and response bias conditions, the HFA group only exhibited these regulatory strategies in the baseline condition.

The Psychophysiology of Self-Regulation

Self-regulation has been thought to depend upon the functioning of the anterior attention system, which includes the midprefrontal and anterior cingulate cortices (Posner & Peterson, 1990; Herrmann, Rommler, Ehliis, Heidrich, & Fallgatter, 2004). It is the ACC that is responsible for executive functions such as resolving conflict and response-monitoring (Andrews, 2001; Gazzaniga, Ivry, & Mangun, 2002; Stuss et al., 2002; Bogte et al., 2007; Bush, Luu, & Posner, 2000). The ACC has been found to be associated with behavioral adjustments following the commission of an error and is thought to be developed by early adolescence (Hogan, Vargha-Khadem, Kirkham, & Baldeweg, 2005). In individuals with autism, abnormalities in the structure and function of the ACC have been indicated (Leigh, Simms, Kaplan, Kemper, Bauman, & Blatt, 2006; Bauman & Kemper, 2005; Gomot et al., 2006; Haznedar et al., 2000; Luna et al., 2002; Blatt et al., 2006; Bogte et al., 2007). One study used fMRI to examine the physiological aspects of response-monitoring in individuals with HFA, and results demonstrated that the ACC is more active during a response-inhibition task in individuals with HFA versus typically

developing individuals (Solomon et al., 2007). In addition, among individuals with autism, correlations between glucose metabolism in areas of the ACC and symptom presentation have been found, such that higher glucose metabolism is related to more parent-reported autistic symptoms in the areas of social interaction, verbal communication, and nonverbal communication (Haznedar et al., 2000).

The ACC becomes active during unfamiliar tasks to indicate when a response is inconsistent with a goal (Posner & Rothbart, 2000; Gehring, Goss, Coles, Meyer, & Donchin, 1993). When discrepancies are noted, behavioral changes are triggered so that the goal can be met (Falkenstein, Hoorman, Christ, & Hohnsbein, 2000; Scheffers & Coles, 2000). Speeded reaction time tasks, such as the Flanker task (Eriksen & Eriksen, 1974), can be used to measure response-monitoring behaviorally and physiologically. Physiological reactions following the commission of an error can be observed by measuring the error-related negativity (ERN) using an electroencephalogram (EEG). Using fMRI technology, the ERN has been localized to the ACC (van Veen & Carter, 2002). The ERN is a negative deflection in the event-related potential (ERP) that occurs approximately 80ms after an error response has been made, and is thought to reflect unconscious error detection (Herrmann et al., 2004; Davies, Segalowitz, Dywan, & Pailing, 2001; Posner & Rothbart, 2000; Dikman & Allen, 2000). The ERN is the first indication that a correction in behavior must be made in order to meet a goal, even before the individual is aware of their mistake. It is this indication that allows individuals to learn to adjust their behavior in order to successfully complete a new task (Holroyd & Coles, 2002).

The more salient the error or the better an individual is at monitoring his/her behavior, the greater the amplitude of the ERN (Tops, Boksem, Wester, Lorist, & Meijman, 2006). For example, when participants are told that accuracy is more important than speed of response, larger ERN amplitudes have been observed (Gehring et al, 1993; Hajcak, Moser, Yeung, & Simons, 2005). In addition, the ERN amplitude on error trials which follow an error trial is typically larger than the ERN on the initial error trial (Ruchow et al., 2006). A larger ERN has also been shown to reflect the importance of social comparison. For example, when individuals are told their performance on a task is being evaluated and compared to the performance of others, larger ERN amplitudes are observed (Hajcak et al., 2005; Tops et al., 2006). This relationship between social sensitivity and ERN amplitude has been found in both children and adults (Santesso, Segalowitz, & Schmidt, 2005; Tops et al., 2006) and may reflect greater engagement of the ACC when errors are more personally relevant and salient (Hajcak et al., 2005).

In addition, individuals with HFA who have relatively higher IQs and fewer social symptoms, exhibit larger ERN amplitudes than individuals with HFA who have relatively lower IQs or neurotypical individuals (Henderson et al., 2006). In addition, these individuals with HFA who exhibit an exaggerated physiological reaction to errors, perform comparably to neurotypical individuals on the behavioral aspects of the Flanker task (e.g., error rates and reaction time), while individuals with HFA who have lower IQs, exhibit poorer performance behaviorally than all other participants (Henderson et al., 2006). These results suggest that the exaggerated physiological reaction to an error may function as a compensatory mechanism, which enables a subgroup of individuals with HFA to perform comparably to typically developing individuals.

Larger ERN amplitudes have also been demonstrated in typically developing individuals when instructed to correct their mistakes immediately following the commission of an error, and the larger the ERN amplitude following the error, the more likely the individual is to successfully correct his/her mistake (Gehring et al., 1993; Fiehler, Ullsperger, & von Cramon, 2005). Hence, for individuals with autism, it would be expected that those individuals who exhibit larger ERN amplitudes, would be more likely to monitor their behavior and learn from their mistakes (i.e., response-monitoring), not only during a speeded reaction time task, but also during social interactions (i.e., social self-monitoring) based on feedback they receive from their peers. Interestingly, such an analysis has never been conducted in either typically or atypically developing individuals. Hence, another primary goal of the current study was to observe individuals with HFA during in vivo social interactions to determine if this was the case.

Study Goals

In summary, the overarching goal of this study was to determine if variation in symptomatology and social skills among individuals with HFA could be predicted by aspects of temperament and self-monitoring. In order to accomplish this, group differences in approach/withdrawal tendencies, response-monitoring, social self-monitoring, and social skills were investigated. Next, predictive analyses were conducted to determine if individual differences in approach/withdrawal tendencies, response-monitoring, and social self-monitoring were predictive of variation in social skills.

Hypotheses

Diagnostic Group Differences

First, it was hypothesized that the HFA group would be less approach oriented compared with the control group and these differences would be expressed as lower levels of self-reported surgency, and fewer approach oriented behaviors during the interaction with an unfamiliar peer (e.g., less sharing of information during a conversation).

Second, it was hypothesized that the HFA group would have lower levels of effortful control, including self-report of effortful control and lower levels of response monitoring, compared with the control group. These differences would be expressed behaviorally and physiologically during the Flanker task (i.e., more errors of commission, less slowing of RT on incompatible trials and trials following errors, and smaller ERN amplitudes).

Third, it was hypothesized that the HFA group would exhibit lower levels of social self-monitoring compared with the control group, as indexed during the social interaction with an unfamiliar peer (e.g., fewer showing actions and verbal directives during teaching task).

Lastly, it was hypothesized that the HFA group would have parent-reported lower levels of social skills, self-reported lower levels of interpersonal relations and higher levels of social stress, and would exhibit deficits in social skills compared with the control group. These deficits would be observed as lower global ratings of appropriate eye contact, conversational efficacy, and social behavior.

Predictive Hypotheses

It was hypothesized that approach/withdrawal tendencies would predict autistic symptoms and social skills, such that higher levels of surgency would predict fewer autistic symptoms and higher levels of social skills. It was further hypothesized that social self-perceptions would partially mediate the association between approach/withdrawal tendencies and symptomatology and social skills.

It was also hypothesized that response-monitoring and social self-monitoring would predict autistic symptoms and social skills, such that a better ability to monitor would predict fewer symptoms and more adaptive social skills.

Chapter 2: Methods

Participants

A total of 60 participants (30 HFA, 30 Control) were seen as part of a larger study examining motivation, self-monitoring, and family processes in higher functioning children with autism. Each group was composed of 5 females and 25 males. However, one male participant from each group was excluded from all analyses due to a failure of the videotaping equipment during the Dyad Interaction. In addition, participants were excluded from certain analyses due to the following reasons: failure to complete the self-report of the Behavioral Assessment System for Children ($n = 2$, 1 HFA, 1 Control); failure to complete the parent-report of the Behavioral Assessment System for Children ($n = 1$ Control); failure to complete the Early Adolescent Temperament Questionnaire ($n = 3$ HFA); failure to complete the EEG collection ($n = 4$ Controls); technical difficulties during EEG collection ($n = 5$ HFA); and fewer than 10 errors committed on the Flanker task ($n = 9$, 4 HFA, 5 Controls). All participants had a WISC-IV Verbal Comprehension Index greater than 70 and did not have a disorder which would have affected the EEG collection, such as a neurological condition. In addition, on the Social Communication Questionnaire (SCQ) and/or the Autism Spectrum Screening Questionnaire (ASSQ), participants in the HFA group met diagnostic cut-offs and participants in the control group did not meet the cut-offs. For the HFA group VCI scores ranged from 77 to 130 ($M = 101.45$; $SD = 14.58$) and age in months ranged from 118 to 215 ($M = 165.03$; $SD = 31.70$). For the Control group VCI scores ranged from 81 to 136 ($M = 106.67$; $SD = 12.24$) and age in months ranged from 115 to 213 ($M = 171.76$; $SD = 27.47$). The groups did not differ on age, $t(1, 56) = -.86$, ns , or IQ, $t(1, 54) = -1.45$, ns .

Through the Center for Autism and Related Disabilities at the University of Miami, letters were sent to parents to recruit children with Asperger Syndrome and high-functioning autism. The sample of typically developing children was recruited from the Miami-Dade County school system through letters given to students to bring home to their parents. The letter included an explanation of the study and a phone number to call if they are interested in participating. Children whose families participated in the study were given \$40 compensation for each of three sessions at Time 1 (T1) and two sessions at Time 2 (T2).

Procedure

For participants in both samples, parents who called the lab were given additional information about the study and asked if they were interested in participating. If they agreed to participate, three lab sessions at T1, one behavioral and two physiological, were scheduled in which temperament and response-monitoring measures were collected. Parents completed informed consent and HIPAA forms, while children completed informed assent forms, all of which were approved by the University of Miami Institutional Review Board, at T1 and T2. During the first session of T1, parents and children completed a set of questionnaires addressing emotional and behavioral functioning and the children completed two verbal subtests of the WISC-IV. During the second and third sessions, EEG was recorded during a baseline condition and an administration of the Flanker task. After completing all assessments at T1, participants were invited to participate in the T2 assessment in which parents completed questionnaires regarding their child's autistic symptoms and social functioning, and

participants completed questionnaires regarding their social functioning and engaged in a social interaction with a participant from the other diagnostic group of the same gender, matched as closely as possible on age and Verbal IQ.

Time 1

Behavioral measures

All participants were administered The Wechsler Intelligence Scale for Children, Fourth Edition (WISC-IV, Wechsler, 2003), which was used to ensure equivalent samples based on the Verbal Comprehension Index (VCI). The WISC-IV has been standardized on 2,200 children and yields standardized estimates for Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. An abbreviated version of the WISC-IV VCI, the vocabulary and similarities subtests only, was used to obtain an estimate of each child's VCI. The reliability and validity for these subtests is very high ranging from .68 to .88. On the WISC-III, Sattler (1988) states that the reliability and validity for IQ scores using the abbreviated version of the WISC-III, vocabulary and similarities subtests, are .905 and .802 respectively. Hence, the WISC-IV abbreviated version should also be considered an appropriate estimate of verbal abilities.

All participants were administered the short form of the Early Adolescent Temperament Questionnaire - Revised (EATQ-R; Ellis & Rothbart, 2001) self-report form, which assesses temperament along 12 dimensions. The 12 dimensions are then combined to form 4 overarching factors: Surgency (i.e., surgency/high intensity pleasure, shyness-reverse scored, fear-reverse scores), Effortful Control (i.e., attention, inhibitory control, activation control), Affiliativeness (i.e., affiliation, perceptual sensitivity,

pleasure sensitivity), Negative Affectivity (i.e., frustration, depressive mood, aggression). Surgency reflects high levels of pleasure from high intensity activities or novelty, low levels of behavioral inhibition, and low levels of unpleasant affect from the anticipation of distress. Effortful Control reflects the ability to perform an action or engage in an activity despite a tendency to avoid it, focus or shift attention, and suppress inappropriate responses. Affiliativeness reflects a desire for warmth and closeness with others, deriving pleasure from familiar and low intensity activities, and the ability to perceive low intensity stimulation in the environment. Lastly, Negative Affectivity reflects high levels of negative affect related to the interruption of a task or goal, loss of enjoyment or interest in activities, and hostile reactivity and actions, including physical or verbal aggression. Participants completed the questionnaire by rating 65 items on a Likert scale from 1 (almost always untrue) to 5 (almost always true). Each dimension consists of four to seven questions. Factors are computed by taking the average of the dimension scores. Reliability and validity for the 10 dimension range from .64 to .81 (Ellis & Rothbart, 2001).

Electrophysiological Collection and Recording

Cap Placement and EEG (Henderson, 2002; Sutton et al., 2005)

Lycra stretch electrocaps, chosen based on each child's head circumference, were used during the EEG collection. Each cap contained tin electrodes placed at the positions matching the international 10-20 electrode system, which recorded from 19 sites on the scalp (F7, F3, Fz, F4, F8, and FCz [frontal], C3, Cz, C4 [central], T7, T8 [anterior temporal], M1, M2 [Mastoids], P3, Pz, P4 [parietal], O1, O2 [occipital]), with a ground

electrode at site AFz. This electrode array was similar to the one used in preliminary studies (Henderson, 2002; Sutton et al., 2005), which enabled efficient cap placement and scalp preparation with both HFA and typically developing samples of children (Sutton et al., 2005). Prior to each recording session, a 50- μ V 10 Hz calibration signal was input into each of the channels. During electrode placement children were allowed to watch a video. A small amount of abrasive Omni-Prep gel was inserted into each of the active sites. Following gentle abrasion, a conducting gel was inserted into the sites and impedances were measured and considered acceptable if each site was at or below 5000 ohms. Pairs of homologous sites with impedances within 2000 ohms were considered acceptable.

EEG collection was referenced to Cz and electro-oculograms (EOG) recorded eye movements. The EOG was recorded using two electrode pairs. The first pair included one electrode placed at the supra-orbit and one at the sub-orbit of one eye. The second pair recorded from the external canthi of each eye. All signals from the EEG cap and the EOG were amplified by a 5000 and used a high-pass filter of 0.1 hertz and the low-pass filter of 100 hertz.

ERN Response-Monitoring Task (Henderson, 2002)

First six minutes of eyes open and eyes closed resting EEG was recorded. Next, response-monitoring was assessed behaviorally and physiologically following error responses using an adapted version of the Eriksen Flanker task. Response-monitoring was measured physiologically by examining the amplitude of the error-related negativity, as well as behaviorally by examining changes in reaction time on trials immediately following

errors of commission (Luu, Flaisch, & Tucker 2000). Children were seated approximately 70 centimeters from a computer monitor and were given a button box with two buttons. A red asterisk appeared in the center of the screen immediately before each target stimulus was displayed above the asterisk. Before cap placement, children completed two shorter blocks of trials, a practice block and a timing block. The experimenter explained the task to the child by instructing him/her to pay attention to the arrows in the middle of the display and to push the button that corresponded to the direction of the center arrow, while ignoring the distracter arrows. The child was given a set of 20 practice trials.

A second set of trials, timing trials, were given immediately following the practice trials. The number of errors committed by the child and their reaction time in this set determined the timing parameters for the testing sessions which included three blocks of 96 trials. For children who performed at 70% correct or above on the timing trials, their median reaction time was used to adjust the amount of time they were given to respond to a stimulus presentation. For children who performed at less than 70% correct, their 75th percentile reaction time was used to select the response time parameter. By creating individual timing parameters for each participant, it increased the likelihood that participants committed at least 10 errors, so that a reliable grand average of the ERN amplitude could be computed. For all participants, the trials consisted of a 200 ms warning cue (an asterisk), a 300 ms delay, and one of four target displays (<<<<<<, >>>>>>, < < > < <, >>< >>) lasting for 200 ms. The four potential target stimuli were each displayed in a counterbalanced order, such that each target was presented equally across the blocks. A correct response required participants to press either the right or left button on the button box corresponding to the direction of the central arrow.

Response-Monitoring Behavioral Analysis

The proportion of correct responses was computed for compatible and incompatible target displays. The RT of each child was recorded for each trial and collapsed across response type (correct/incorrect), trials following each response type (trial following correct/incorrect), and stimulus type (compatible/incompatible). RT reflects the time from the stimuli presentation to either, the button press by the child or the end of the trial, depending on which comes first. Behavioral indices of response-monitoring were computed by examining the number of errors committed, taking the difference in reaction time (RT) on incompatible and compatible trials, and taking the difference in RT on trials following error and correct responses. A positive difference score reflects the slowing down of responding on the more challenging incompatible trials or following the commission of an error, which indexes the degree to which a participant registers and responds to his/her own errors (i.e., the degree to which they response-monitor; Posner & Rothbart, 1998, 2000). In addition, a slowing of RT on trials following errors is indicative of increased response-monitoring.

EEG Response-Monitoring Analysis (Henderson, 2002)

The EEG was visually reviewed off-line by the researcher in order to identify and remove any additional sources of artifact. A regression analysis was used to correct for artifact from eye movements and rereferenced to the average of the mastoids. In order to examine children's responses to the commission of errors, the artifact-free EEG was response-locked (correct/incorrect) and averaged for each participant. Prior to the response, between -200 and -50 milliseconds, the EEG was baseline corrected and digitally

refiltered with a 30 hertz low pass filter. To compute the error-related negativity (ERN), a second baseline correction, 100 milliseconds prior to the response, was computed and, again, refiltered with a 30 hertz low pass filter. Lastly, the ERN was computed as the average negative peak voltage (i.e., the minimum voltage value), occurring 10 to 150 milliseconds following a response, across all trials that were errors of commission.

Time 2

Autism Symptomatology

Parents were asked to complete the Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles, & Bailey, 1999) and the Autism Spectrum Screening Questionnaire (Ehlers, Gillberg & Wing, 1999). The SCQ is a valid parent-report measure for the screening or verification of Autism Spectrum Disorder symptoms based on the 40 critical items of the Autism Diagnostic Interview (Berument et al., 1999). The criterion score for the SCQ is 15 (Rutter, Bailey, Berument, Lord, & Pickles, 2003). The ASSQ was developed as a brief screening device for symptoms of Asperger Syndrome or high-functioning autism, in children and adolescents with normal intelligence or mild mental retardation. The measure is a 27 item parent-report checklist with a criterion score of 27 (Ehlers et al. 1999).

Social and Emotional Functioning

The Behavioral Assessment System for Children Self- and Parent-Report of Personality (BASC-2; Reynolds & Kamphaus, 2004) is an instrument used to elicit self- and parent-report of the child's emotional functioning. The child self-report forms are completed by

circling either true or false, or never, sometimes, often, or almost always, in response to an extensive list of simple, straight-forward statements. The parent-report forms are completed by circling: never, sometimes, often, or almost always. Parent report forms...or almost always, and are available in two forms based on age: child (6-11) and adolescent (12-21). The parent-report form contains an anxiety and social skills scale, and the self-report form contains anxiety, social stress, and interpersonal relations scales. Reliability and validity for the 10 dimension range from .67 to .95.

Social Anxiety was assessed using the child self-report version of the Social Anxiety Scale for Children –Revised (SASC-R; La Greca & Stone, 1993), which is composed of 22 items rated on a Likert scale from 1 (not at all) to 5 (all the time). The measure contains three scales: Fear of Negative Evaluation from Peers (FNE; 8 items), e.g. “I worry about being teased,” Social Avoidance and Distress-Specific (SAD-N; 6 items), e.g. “I worry about doing something new in front of other kids,” and Social Avoidance and Distress-General (SAD-G; 4 items), e.g. “I’m quiet when I’m with a group of kids.” Scale totals were obtained by taking the mean of the scores of the items in the scale and an overall total was obtained by summing the subscale scores. The SASC-R has been demonstrated to have adequate reliability and validity with internal consistency for the subscales ranging from .60 to .90 in both clinical and typical samples (Epkins, 2002; Ginsburg, La Greca, & Silverman, 1998; LaGreca & Stone, 1993; Morris & Masia, 1998).

Friendship Measures

The Friendship Qualities Scale (FQS; Bukowski, Hoza, & Boivin, 1994; Hoza, Bukowski, & Beery, 2000) is a self-report questionnaire used with children and adolescents to measure the amount of companionship, conflict, help/aid, security, and closeness they perceive in their relationship with their self-identified best friend. The scale asks children to write the name of their best friend at the top of the questionnaire and then answer 46 items, each rated on a 5 point Likert scale, ranging from 1 (not true) to 5 (really true), about their relationship with this friend. The FQS has demonstrated adequate reliability and validity with internal consistency for each scale ranging from .68 to .77.

The Loneliness and Social Dissatisfaction Questionnaire (LSDQ; Asher, Hymel, & Renshaw, 1984; Asher, Parkhurst, Hymel, & Williams, 1990; Parkhurst & Asher, 1987, 1992) is a self-report questionnaire that is used to assess feelings of loneliness and dissatisfaction with peer relationships at school. There are 16 primary items and 8 filler items each of which is rated along a five point Likert scale from 1 (always true) to 5 (not true at all). Among older children, the scale demonstrates adequate reliability and validity with an internal consistency of .90.

The Network of Relationship Inventory (NRI; Furman & Buhrmester, 1985) is a self-report questionnaire that is used to assess perceived support and conflict in important relationships along 10 dimensions, including companionship, conflict, intimacy, affection, relative power, and reliable alliance. The questionnaire allows participants to name up to eight important people in their lives for whom they will assign ratings. Each question is rated along a five point Likert scale from 1 (little or none) to 5 (the most). The

scale demonstrates adequate reliability and validity with internal consistencies ranging from .47 to .80.

Dyad Interaction Observation Protocol

During the T2 assessment one child from each diagnostic group, matched as closely as possible on gender, age, and IQ, completed the social interaction protocol. This interaction was videotaped for later viewing by three coders.

Greeting

To begin the interaction, the child from the control group was taken to the observation room and was seated at a desk working on a questionnaire. The child with HFA was brought into the observation room and briefly introduced to the child from the control group. The child with HFA was instructed to complete the same questionnaire as the child from the control group and the researcher left the room.

Get to Know You

After both children completed the questionnaire, the researcher entered the room and told them they had five minutes to get to know each other. The researcher then left the room. *Approach/Withdrawal* tendencies were measured during the conversation by the total time each child spent talking during the five minutes and a frequency count of the number of times each child shared information about him/herself. Interrater reliability (Pearson correlations) between pairs of coders for the total time talking ranged from .97 to .99 and for the frequency of sharing information ranged from .85 to .94. *Social Skills* were also measured during the conversation by global ratings on a Likert scale from 1(totally inappropriate) to 5(completely appropriate) for eye contact, conversational

efficacy, and the overall appropriateness of the interaction. Interrater agreement (percentage of agreement within one) between pairs of coders for eye contact ranged from .75 to .88, for conversational efficacy ranged from .75 to 1.0, and for overall appropriateness ranged from .81 to .94.

Teaching Task

After five minutes elapsed, the researcher returned to the room and instructed each participant to choose a task to teach their peer. There were three tasks to choose from and a set of materials for each child. The tasks included making a drawing, a construction out of 'Tinker Toys', and an origami cat. Each task had the same number of steps to follow in the directions. The 'teacher' had step-by-step directions for how to complete the task and was instructed to make sure their peer completed the task correctly. The teacher was also instructed to only touch the objects in their own set of materials. The child in the HFA group was given the first choice of tasks and was instructed to be the teacher first, so that they were not influenced in their teaching method by their peer. *Social Self-Monitoring* was measured during this task by coding the teacher's behavior for the number of looks at their peer, showing actions, and verbal directives. There was also a global code for teaching efficacy from 1 (poor teaching/self-monitoring) to 5 (excellent self-monitoring). Interrater reliability (Pearson correlations) between pairs of coders for looks at their peer ranged from .89 to .91, for shows ranged from .93 to .97, and for verbal directives ranged from .97 to .99. For the global rating of teaching efficacy, interrater agreement (percentage of agreement within one) between pairs of coders ranged from .81 to 1.0.

Teamwork Task

The last task was a team work task in which participants were instructed to work together to brainstorm one list of the top ten movies ever made. This task assessed *Approach/Withdrawal* using a frequency count of the number of suggestions made, and *Social Skills* using a global rating of the appropriateness of the interaction from 1 (poor social skills/completely inappropriate) to 5 (excellent social skills/very appropriate). Interrater reliability (Pearson correlations) between pairs of coders ranged from .93 to .98 for the number of suggestions made and interrater agreement (percentage of agreement within one) between pairs of coders ranged from .88 to 1.0 for appropriateness of the interaction.

Outlier Assessment

For each variable coded during the interaction, outliers within each group were examined using a box plot. Any score falling greater than three interquartile ranges outside of the distribution was examined. On the Teaching Task two individuals in the HFA group were determined to be outliers on the number of looks to their peer and one child from each diagnostic group was determined to be an outlier on the number of shows. These four scores were excluded from analyses. Four participants in the control group were labeled as outliers in the boxplot for the global rating of eye contact during the Get to Know You segment. However, after examining the individual's scores they were not excluded from analyses because doing so would have eliminated all participants who did not receive a score of five on this measure.

Chapter 3: Results

Preliminary Analysis and Data Reduction

Dyad Interaction

All variables were examined to ensure values for skew were less than four and kurtosis less than 10. Correlation analyses were conducted across all participants and separately by group to examine the relations among variables hypothesized to index *Approach/Withdrawal*, *Social Skills*, and *Social Self-Monitoring*. Based on analyses (See Tables 1a and 1b), the total time talking and the number of shares during the *Get to Know You* segment along with the number of suggestions made during the Teamwork Task were combined to form the *Approach/Withdrawal* Dyad Factor. The number of looks at their peer, showing actions, verbal directives, and the global rating of teaching efficacy during the Teaching Task were combined to form the *Social Self-Monitoring* Dyad Factor. Lastly, the global ratings of eye contact, conversational efficacy, and appropriateness during the *Get to Know You* segment, along with the global rating of appropriateness during the Teamwork Task were combined to form the *Social Skills* Dyad Factor. All factors were created by averaging the Z-scores of the individual variables. To examine the relations between Dyad Factors, correlation analyses were conducted across all participants and separately by group (See Tables 2a and 2b). Across all participants, *Social Self-Monitoring* and *Social Skills* were significantly positively correlated. In the HFA group, there were no significant relations between the Dyad Factors. In the control group, as hypothesized, *Social Skills* was significantly positively

correlated with *Approach/Withdrawal* and was positively correlated with *Social Self-Monitoring* at the level of a trend, while *Approach/Withdrawal* and *Social Self-Monitoring* were not related.

Response Monitoring

To determine if one measure of Response Monitoring could be formed, correlation analyses were conducted to examine the relations among the four measures of Response Monitoring: ERN at Fz, ERN at FCz, slowing in reaction time following an error, and slowing on incompatible trials (See Tables 3a and 3b). Only ERN at Fz and FCz were correlated across all participants and hence were combined to form the *ERN Amplitude* composite.

Global Factors

After creating factors based on the Dyad Interaction, correlation analyses were conducted across all participants and separately by group to examine the hypothesized relations between Dyad Factors and other indices of *Approach/Withdrawal*, *Effortful Control*, and *Social Skills* (See Tables 4a and 4b). Examining the correlation analyses across all participants, the *Approach/Withdrawal* Dyad Factor was not related to self-report of Surgency. To examine *Effortful Control*, the Social Self-Monitoring Dyad Factor was correlated with measures of Self-Regulation from the Flanker task and the self-report of Effortful Control Factor from the EATQ. Social Self-Monitoring was significantly positively correlated with Effortful Control. There were no significant

relations in either group between *Social Self-Monitoring* and measures from the Flanker Task. Hence, *Social Self-Monitoring* and the Effortful Control Factor from the EATQ were combined to form the *Effortful Control* Factor.

Lastly, the *Social Skills* Dyad Factor was correlated with scales on the BASC self- and parent-report form pertaining to social interaction (See Tables 4a and 4b). Results across all participants indicated that individuals who exhibited more adaptive *Social Skills* during the peer interaction, self-reported better interpersonal relations and lower levels of social stress. There was no relation between the *Social Skills* Dyad Factor and parent-report of social skills. Hence, the *Social Skills* Dyad Factor, self-report of interpersonal relations and self-report of social stress were combined to form the global *Social Skills* Factor.

Friendship Measures

To determine if one measure of *Positive Friendship Perceptions* could be formed, correlation analyses were conducted to examine the relations among scales on the NRI and FQS across all participants and separately by group. Eight scales from the NRI (See Tables 5a and 5b) and five scales from the FQS (See Table 6a and 6b) were found to be positively intercorrelated for both groups. As a result, a composite of positive friendship perceptions for each measure was created by taking the average Z-score of the scales. Next, a correlation analysis was performed to determine if the NRI, FQS, and LSDQ could be combined to form one final composite of *Positive Friendship Perceptions*. Results (See Table 7a and 7b) indicated that there was a significant positive correlation between the positive friendship composites of the NRI and FQS across all participants.

Neither measure was correlated with the LSDQ. Hence, the NRI and FQS were combined by taking the average *Z*-scores to create the *Positive Friendship Perceptions* composite.

Hypothesis Testing

Between Group Analyses

A multivariate ANOVA was conducted to examine group differences on the four temperament factors, which revealed a main effect of group, $F(4, 49) = 2.95, p = .029, \eta^2 = .19$. Follow-up univariate ANOVAs revealed group differences on self-report of Negative Affectivity, $F(1, 52) = 10.27, p < .01, \eta^2 = .17$, and Surgency, $F(1, 52) = 5.58, p = .022, \eta^2 = .10$, such that the HFA group reported higher levels of Negative Affectivity and lower levels of Surgency than the control group. The groups did not differ on self-reported Effortful Control, $F(1, 52) = .82, ns, \eta^2 = .02$, or Affiliativeness, $F(1, 52) = 1.43, ns, \eta^2 = .03$, (See Figure 1).

Follow-up multivariate ANOVAs were conducted to determine which scales within the Negative Affectivity and Surgency factors drove the overall group differences. Regarding the Negative Affectivity factor, the HFA group reported significantly higher levels of depressive mood, $F(1, 52) = 8.33, p < .01, \eta^2 = .14$, aggression, $F(1, 52) = 5.83, p = .019, \eta^2 = .10$, and frustration, $F(1, 52) = 4.46, p = .040, \eta^2 = .08$ (See Figure 2). On the Surgency factor, group differences existed for the surgency scale, $F(1, 52) = 7.35, p = .009, \eta^2 = .12$, but not for shyness, $F(1, 52) = .97, ns, \eta^2 = .02$, or fear, $F(1, 52) = 1.99, ns, \eta^2 = .04$, such that the HFA group reported lower levels of surgency (See Figure 3).

A multivariate ANOVA was conducted to examine group differences on the *Approach/Withdrawal*, *Social Self-Monitoring*, and *Social Skills Dyad* Factors, which

revealed a main effect of group, $F(3, 54) = 10.48, p < .001, \eta^2 = .37$. Follow-up univariate ANOVAs revealed group differences on *Approach/Withdrawal*, $F(1, 56) = 6.41, p = .014, \eta^2 = .10$, and *Social Skills*, $F(1, 56) = 16.14, p < .001, \eta^2 = .22$, but not *Social Self-Monitoring*, $F(1, 56) = .93, ns, \eta^2 = .02$, such that the HFA group exhibited more approach oriented behavior and less adaptive social skills during the peer interaction (See Figure 4).

A multivariate ANOVA analyzing the variables composing the *Approach/Withdrawal* Dyad Factor revealed significant group differences on the total time talking, $F(1, 54) = 10.73, p < .01, \eta^2 = .17$, and the number of shares, $F(1, 54) = 11.65, p < .01, \eta^2 = .18$, during the Get to Know You segment, but not on the number of suggestions made during the Teamwork Task, $F(1, 54) = .58, ns, \eta^2 = .01$, such that the HFA group talked significantly more and made significantly more sharing verbalizations during the Get to Know You segment than the control group (See Figure 5).

A multivariate ANOVA was also used to examine group differences on the variables composing the *Social Skills* Dyad Factor. Results indicated that the HFA group was rated as exhibiting lower global ratings of eye contact, $F(1, 54) = 19.91, p < .001, \eta^2 = .27$, and overall appropriateness during the Get to Know You segment, $F(1, 54) = 14.63, p < .001, \eta^2 = .21$, but not conversational efficacy, $F(1, 54) = 2.04, ns, \eta^2 = .04$. The HFA group also received lower ratings of overall appropriateness during the Teamwork Task, $F(1, 54) = 15.34, p < .001, \eta^2 = .22$ (See Figure 6).

A multivariate ANOVA was used to examine group differences on the three scales from the BASC related to social functioning, revealing a main effect of group, $F(3, 51) = 12.19, p < .001, \eta^2 = .42$. Follow-up univariate ANOVAs indicated that the HFA

group had lower levels of parent-reported social skills, $F(1, 53) = 20.63, p < .001, \eta^2 = .28$, and self-reported higher levels of social stress, $F(1, 53) = 12.94, p = .001, \eta^2 = .20$, and lower levels of interpersonal relations, $F(1, 53) = 10.19, p < .002, \eta^2 = .16$.

Examining the Flanker task measures of Response-Monitoring, both behaviorally and physiologically, there were no significant differences between the groups on ERN amplitude, $F(1, 35) = .33, ns, \eta^2 = .01$, or reaction time slowing on the trial following an error, $F(1, 35) = 1.48, ns, \eta^2 = .04$. There was a trend towards group differences on the total number of errors committed, $F(1, 52) = 3.95, p = .052, \eta^2 = .07$, and reaction time slowing on incompatible versus compatible trials, $F(1, 52) = 3.64, p = .062, \eta^2 = .07$, such that the HFA group committed more errors and slowed their reaction less on incompatible trials.

Predictive Analyses

To test the hypothesized predictive relations between diagnostic group, *Approach/Withdrawal*, *Effortful Control*, *Social Skills*, and Symptomatology, four hierarchical multiple regression analyses were performed. For all analyses the predictor variables were centered before being entered into the regression analyses and multicollinearity for each analysis was examined by ensuring tolerance values close to 1, variance inflation factor (VIF) values less than 10, condition numbers less than 15, and low correlations between coefficients. Interaction terms were created by multiplying the dummy coded grouping variable by the predictor. For the first two regression analyses the centered predictors were entered in the following order: 1) the dummy coded grouping variable; 2) the *Approach/Withdrawal* Dyad Factor; 3) the *Effortful Control*

Factor; 4) the interaction between diagnostic group and *Approach/Withdrawal*; and 5) the interaction between diagnostic group and *Effortful Control*. The first analysis used the *Social Skills* Factor as the criterion measure (See Table 8). The overall model accounted for a significant portion of the variance in *Social Skills*, $F(5, 50) = 6.57, p < .001$. There were significant main effects of diagnostic group and *Effortful Control*. *Effortful Control* accounted for an additional six percent of unique variance in *Social Skills*, after controlling for diagnostic group and *Approach/Withdrawal*. The individual regression coefficients indicated that while the HFA group exhibited lower levels of *Social Skills* than the control group, across all participants higher levels of *Effortful Control* were predictive of higher levels of *Social Skills* (See Figure 7).

For the second regression, the order of entry of predictors into the model remained the same, but the criterion measure was parent-report of symptoms on the ASSQ (See Table 9). The overall model accounted for a significant portion of the variance in symptoms, $F(5, 48) = 31.78, p < .001$. However, examining the individual regression coefficients, only diagnostic group accounted for a significant portion of unique variance in symptoms, such that the HFA group was rated as exhibiting significantly more symptoms than the control group. *Approach/Withdrawal* and *Effortful Control*, alone or in combination with diagnostic group, did not account for unique variance in symptoms after controlling for diagnostic group.

For the next set of regression analyses, the average ERN amplitude at Fz and FCz was substituted in the place of *Effortful Control* in the regression model. For the third regression, *Social Skills* was again used as the criterion (See Table 8). The overall model accounted for a significant portion of the variance in *Social Skills*, $F(5, 38) = 4.53, p < .01$.

However, examining the individual regression coefficients, only diagnostic group accounted for a significant portion of unique variance in *Social Skills*, such that the HFA group exhibited significantly lower levels of *Social Skills* than the control group. *Approach/Withdrawal* and ERN Amplitude, alone or in combination with diagnostic group, did not account for unique variance in *Social Skills* after controlling for diagnostic group.

For the final regression analysis, ASSQ was used as a measure of current symptom presentation (See Table 9). The overall model was significant, $F(5, 35) = 30.69$, $p < .001$, and results indicated that after controlling for all main effects, the interaction between diagnostic group and ERN amplitude accounted for an additional 4.3 percent of unique variance in symptoms (See Figure 8). Post hoc correlation analyses indicated that larger (i.e., more negative) amplitude ERN was related to more parent-reported symptoms in the HFA group, $r(23) = -.51$, $p = .010$, but not the control group, $r(16) = .22$, *ns*.

To test the hypothesized role of *Positive Friendship Perceptions* as mediating the relation between *Approach/Withdrawal* and *Social Skills*, as well as the relation between *Approach/Withdrawal* and symptom presentation, a series of multiple regression analyses were initiated (See Table 10). The centered variables were entered in the following order: 1) the dummy coded grouping variable; 2) the *Approach/Withdrawal* Dyad Factors; and 3) the interaction between diagnostic group and *Approach/Withdrawal*. The overall model accounted for a significant portion of the variance in *Social Skills*, $F(3, 52) = 7.85$, $p < .001$. However, only diagnostic group accounted for a significant amount of unique variance in *Social Skills*, such that the HFA group exhibited lower levels of *Social Skills*

than the control group. A significant amount of additional variance in *Social Skills* was not accounted for by *Approach/Withdrawal*, alone or in combination with diagnostic group, after controlling for group status. Similarly, when symptom presentation was used as the criterion measure, the overall model accounted for a significant portion of the variance in symptoms, $F(3, 50) = 53.74, p < .001$. However, only diagnostic group accounted for a significant portion of unique variance in symptoms, such that the HFA group exhibited higher levels of symptoms than the control group. A significant amount of additional variance in symptoms was not accounted for by *Approach/Withdrawal*, alone or in combination with diagnostic group, after controlling for group status. Hence, no further analyses were conducted to examine the meditation model.

Post-hoc Exploratory Analyses

Due to behavioral observations during data collection and the unexpected finding that *Approach/Withdrawal* was not related to the Surgency temperament factor, the relation between the *Approach/Withdrawal* Dyad Factor and anxiety was explored. First, the correlations between the self- and parent-report BASC anxiety scales and the SASC scales were examined and found to be interrelated (See Table 11). Since the SASC total score is a sum of the three scales, an *Anxiety* Factor was created by taking the average z-scores of the self- and parent-report BASC anxiety scales and the SASC total score. Next, *Approach/Withdrawal* and *Effortful Control* were correlated with the *Anxiety* factor (See Table 12), which indicated that higher levels of *Approach/Withdrawal* were related to higher levels of anxiety across all participants. Finally, one hierarchical regression analysis was conducted in which *Anxiety* was used as the criterion and the predictors

were entered in the following order: 1) the dummy coded grouping variable; 2) *Approach/Withdrawal*; 3) *Effortful Control*; 4) the interaction between diagnostic group and *Approach/Withdrawal*; and 5) the interaction between diagnostic group and *Effortful Control*. The overall model accounted for a significant portion of the variance in *Social Skills*, $F(5, 52) = 5.58, p < .001$. In addition, *Approach/Withdrawal* accounted for an additional 3.6 percent of unique variance in *Social Skills* above diagnostic group (See Table 13). Examining the individual regression coefficients, higher levels of *Approach/Withdrawal* (See Figure 9) were predictive of higher levels of *Anxiety*.

In addition, due to a lack of relation between *Approach/Withdrawal*, symptoms, and *Social Skills*, the mediation model utilizing *Positive Friendship Perceptions* could not be tested. However, exploratory analyses examined the correlation between *Positive Friendship Perceptions*, *Approach/Withdrawal*, *Effortful Control*, *Social Skills*, and symptoms across all participants and separately by group (See Table 14). Results indicated that higher levels of self-reported *Positive Friendship Perceptions* were related to lower levels of parent-reported symptoms. Hence, a regression analysis was conducted in which predictors were entered in the following order: 1) the dummy coded grouping variable; 2) *Positive Friendship Perceptions*; and 3) the interaction between diagnostic group and *Positive Friendship Perceptions* (See Table 15). The overall model accounted for a significant portion of the variance in symptoms, $F(3, 50) = 60.36, p < .001$. In addition, *Positive Friendship Perceptions* accounted for an additional 2.6 percent of unique variance in symptoms after controlling for diagnostic group. Examining the individual regression coefficients, higher levels of *Positive Friendship Perceptions* were predictive of lower symptom levels regardless of group status (See Figure 10).

Chapter 4: Discussion

Social skill development and the formation of positive peer relationships have been demonstrated to be areas of extreme difficulty among individuals with autism. However, as is seen in typical development, great variability in social skills and life outcomes have been documented among even the highest-functioning individuals with autism (McGovern & Sigman, 2005; Barnard et al., 2001). Many within-child factors have been shown to be related to the development of social competence in children, including temperament and the ability to inhibit impulses and regulate emotions (Sanson et al., 2004; Rothbart & Bates, 1998; Seifer, 2000; Zins, Elias, Greenberg, & Weissberg, 2000). Research has shown that symptom levels and cognitive functioning do not directly predict life outcomes for individuals with autism (Ozonoff et al., 2004; Sigman & Ruskin, 1999). Rather, adaptive skills such as social competence play a large role in the ability of an individual with autism to maintain employment and succeed in life (Sigman & Ruskin, 1999). As children enter adolescence, social interactions, and the formation of peer relationships, take on increasing importance and become one of the most salient environments in which adolescents are a part. Research cannot rely solely on self- and parent-report measures to assess children's social functioning with peers. Hence, this study is unique, in that a novel observational measure was developed to assess adaptive social skills in a peer context. This study set out to investigate whether or not aspects of temperament could be used to predict individual differences in symptom presentation and social skills among individuals with HFA. The overarching goal was to provide insight into factors that may be targeted in the development of treatments specifically designed for individuals with HFA to help ensure more adaptive life outcomes.

The first goal of this study was to examine group differences in temperament and social skills. In regard to mean group differences in temperament, as hypothesized, the HFA group self-reported lower levels of Surgency and higher levels of Negative Affectivity than the control group. Follow-up analyses on the dimensions that comprise these two factors indicated that the HFA group reported lower levels of surgency, and higher levels of frustration, aggression, and depressed mood than the control group. Conversely, during the peer interaction, the HFA group exhibited more approach oriented behaviors than the control group, as indexed by more time spent talking and more sharing of information during the Get to Know You segment of the peer interaction. No group differences were found for the self-report of Effortful Control or Affiliativeness. Similar results were found during the peer interaction, as there were no group differences in *Social Self-Monitoring*, as indexed by a similar number of looks to their peer, verbal directives, and showing behaviors, as well as by similar global ratings of teaching efficacy during the Teaching Task.

The finding that the HFA and control groups differed only on the surgency dimension and not on the shyness dimension of the Surgency factor, at first appears surprising. However, previous research has suggested that high levels of surgency do not simply reflect low levels of shyness, but the two dimensions constitute separate constructs with different underlying neural systems (Polak & Gunnar, 2006). In addition, the differences between these dimensions can be seen when examining the items that compose the two scales. The way in which surgency is assessed reflects the extent to which an individual gains pleasure from a high intensity activity, such as being in a large

crowd. Individuals with autism, even those with HFA, tend to exhibit sensory sensitivities that prohibit this type of activity from being enjoyable and hence, group differences are not surprising.

Given that the HFA group reported lower levels of surgency than the control group, it was surprising that the HFA group exhibited higher levels of approach oriented behavior during the peer interaction. One possible explanation is that while the self-report measure of surgency assesses for interest in high-intensity activities, the peer interaction measured approach behaviors in a structured interaction with only one other individual, a situation in which sensory sensitivity would not be an issue for participants with HFA. A second explanation for the divergent results is the post-hoc finding that high levels of approach behavior during the interaction were predictive of higher levels of *Anxiety*. While it was hypothesized that more approach oriented behaviors would predict more adaptive functioning, post-hoc analyses were conducted to examine the relationship between *Approach/Withdrawal* and *Anxiety*. The decision to explore this relationship was based on observations during the interactions which indicated that some of the participants who were most anxious about the interaction were also some of the most talkative. This is consistent with research indicating that one expression of anxiety is to increase the volume and rate of speech (Siegman & Boyle, 1993). Similarly, clinical experience suggests that when faced with interpersonal interactions with an unfamiliar peer, socially anxious individuals may attempt to avoid uncomfortable moments of silence by dominating the interaction and filling the time with pressured speech. While the relation between approach behavior and anxiety was true for all participants regardless of diagnostic group, the HFA group exhibited significantly more approach

(i.e., anxious) behaviors than the control group during the Get to Know You segment, which occurred at the beginning of the interaction. In future research it would be interesting to counterbalance the presentation of activities during the interaction to observe if anxious individuals would react differently if given more time to adjust to the situation and to their peer before being asked to have a conversation with them. In addition, future research may be better able to differentiate between social motivation and social anxiety by observing participants, not only in a dyadic interaction, but also in a small group setting. When the interaction is one-on-one, anxious participants may cope with the situation by dominating the interaction, whereas in a group this would become much more challenging. Hence, a group setting may create more opportunities to observe the differences between social motivation (i.e., approach behavior) and social anxiety. For example, in a group, social anxiety may be more clearly observed as a lack of participation in the conversation. Anxious individuals may hover near the group in the hopes of becoming engaged in the interaction, but may not be successful in engaging with their peers. Social motivation on the other hand, might be examined by assessing the amount of time the participants are engaged with their peers and appropriately involved in the group conversation. In addition, it would be interesting to examine differences between participant's expressions of positive affect in a one-on-one versus small group setting. It might be expected that the expression of positive affect for approach oriented participants would not differ across the two setting, but individuals who are socially anxious would likely express less positive affect in the group setting.

In regard to a lack of group difference on the shyness dimension of the EATQ, this dimension reflects social inhibition, a construct that shows great variability in

typically developing individuals (Rothbart & Derryberry, 1981; Fox, Henderson, Marshall, Nichols, & Ghera, 2005). Clinical experience suggests that among individuals with HFA there is great variability in this construct as well, as some individuals with HFA are extremely inhibited in the presence of their peers or with unfamiliar children and adults, while others are much more outgoing and interactive. Hence, this finding is the first to illuminate the possibility that variability in shyness may be independent of diagnostic status. In addition, this lack of group difference in shyness may suggest that the social deficits that are seen in individuals with autism are less related to a lack of social interest or motivation and are more related to the deficits in social skills that are central to a diagnosis of autism. This interpretation is also consistent with the finding that there were no group differences on the Affiliativeness factor of the EATQ, which assesses for a desire to be close with others. The literature examining home videos of children later diagnosed with an autism spectrum disorder have consistently found deficits in eye gaze evidenced by either a lack of eye-to-eye gaze or atypical eye gaze (Adrien et al., 1991; Maestro et al., 2001; Osterling & Dawson, 1994; Trepagner, 1996). Often times this is attributed to a deficit in the desire for social interaction. However, these results may actually reflect a deficit in social cognition, rather than social motivation. This interpretation of the literature supports the findings here, which suggest that adolescents with HFA have a desire for close relationships comparable to their typically developing peers, but may lack the skills needed to appropriately seek out reciprocal and satisfying friendships. This deficit in adaptive social skills was observed during the peer interaction. This was not a surprising finding, since deficits in social skills are known to be a defining feature of autism. The global codes used to assess *Social*

Skills during the Dyad Interaction, measured eye contact and overall appropriateness during interactions, which are clearly assessing behaviors that are known to be related to the core symptoms used for the diagnosis of individuals with autism.

Interestingly, however, results of predictive analyses indicated that regardless of diagnostic group, higher levels of *Effortful Control* were predictive of more adaptive *Social Skills*. Similar results were reported by Ozonoff et al. (2004), finding that while executive functioning was not related to symptom presentation among individuals with HFA, it was positively correlated with adaptive skills. These results are consistent with a large literature on typically developing individuals stating that a better ability to regulate behaviors and emotions is related to more adaptive social behaviors (Spinrad et al., 2004) and is important for the development of social competence (Matson & Coatsworth, 1998; Eisenberg, Liew, & Pidada, 2004; Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006). These finding also fit well with the ‘modifier model’ of autism (Mundy, Henderson, Inge & Coman, 2007), which suggests that etiological processes specific to autism interact with modifiers to influence variability in the behavioral phenotype of individuals with HFA at different points in development. These modifiers are not syndrome specific; they are constructs such as socialization processes and temperament, which vary across all individuals, and influence outcomes, such as social skills, comorbidity, and treatment response in individuals with HFA (Mundy et al., 2007). The results of this study suggest that *Effortful Control* is one such construct that influences outcome for individuals with autism.

A lack of group differences on *Effortful Control*, *Social Self-Monitoring*, and ERN amplitude additionally support the ideas presented by Mundy et al. (2007)

suggesting that certain constructs, such as temperament, or biological processes, such as ERN amplitude, exert a similar influence over developmental processes regardless of diagnosis. While executive dysfunction has been frequently found among individuals with autism (Pennington & Ozonoff, 1996), results to the contrary have also been noted. For example, impulsive responding during a speeded reaction time task was found in both a sample of adults with HFA and a control group matched on age and IQ (Bogte, Flamma, van der Meere, & van Engeland, 2007). There are several possible explanations for the lack of group differences presented in the current study. First, self-regulation is considered to be one aspect of executive functioning. Hill (2004) reported that when comparison groups are well matched to the autism group based on “ability level” (p. 191), such as IQ, in addition to matching for chronological age, group differences in executive functioning tend to be lessened. Hence, in many ways the lack of group differences on *Effortful Control*, *Social Self-Monitoring*, and ERN amplitude in the current study are consistent with the literature that has employed well-matched control groups. Second, previous studies reporting deficits in self-regulation among individuals with autism compared with typically developing individuals (Kasari & Sigman, 1997; Konstantareas & Stewart, 2006) have tended to be based on parent-report data. The finding in the current study was based on self-report, observational, and psychophysiological data. One possibility for the difference in reporting could be that self-regulation may be a difficult aspect of temperament to observe, even for parents. Parents may view their children as having deficits in self-regulation, while children self-report levels comparable to their peers. While parents have a certain standard for their child’s behavior and view their child as exhibiting deficits regulating their behavior

appropriately, the child may be using their self-regulatory skills to the best of their ability in order to improve their behavior to the level the parents observe. However, continued research in this area including multiple modes of measurement and separate assessments of different aspects of executive control, beyond parent- and child-report, is clearly needed to determine if this is the case.

Even though there were no group differences in ERN amplitude, among the HFA group, larger amplitude ERN, which is generally thought to reflect a better ability to self-monitor, was found to predict more parent-reported symptoms of autism. The ERN has been localized to the Anterior Cingulate Cortex (ACC; van Veen & Carter, 2002) and abnormalities in the structure and function of the ACC have been demonstrated among individuals with autism (Leigh, Simms, Kaplan, Kemper, Bauman, & Blatt, 2006; Bauman & Kemper, 2005; Gomot et al., 2006; Haznedar et al., 2000; Luna et al., 2002; Blatt et al., 2006; Bogte et al., 2007). Functional abnormalities in the ACC, such as increased glucose metabolism, have been related to more parent-reported autistic symptoms (Haznedar et al., 2000) and dysfunction in the ACC is also thought to interfere with the development of intersubjectivity, joint attention, and social cognition in individuals with autism (Mundy, 2003). In addition, examining the individual items from the symptom measure, the ASSQ, it appears as if the items assess many rigid behaviors that are common among the most high-functioning individuals with autism. Similar behaviors are observed in individuals with Obsessive Compulsive Disorder (OCD), such as expressing sounds involuntarily or repeating idiosyncratic routines. Individuals with OCD, tend to have an overactive error monitoring system compared with controls, which causes exaggerated ERN amplitudes following an error (Gehring, Himle, & Nisenson,

2000). A similar process may be at play in this study, such that individuals with HFA who are hypersensitive to their errors exhibited more parent-reported symptoms primarily due to elevations on rigid and compulsive behaviors. Although this association was not observed in the control group, this could be due to a floor effect since many participants in the control group were rated as exhibiting very few autistic symptoms.

Additionally, no group differences were noted on the slowing in reaction time on the trial following an error during the Flanker task, but the HFA group committed more errors and slowed their reaction time less on incompatible trials than the control group. This suggests that while participants in the HFA group recognized their errors on a physiological level and were able to slow their reaction time comparably to the control group on subsequent trials, this slowing was not enough to enable them to commit fewer errors. The HFA group exhibited additional deficits in response monitoring evidenced by a lack of slowing in reaction time on the more challenging incompatible trials, which also may have contributed to an increased error rate. Another explanation of the increased error rates and lack of slowing on incompatible trials may be the high rates of comorbid symptoms of Attention Deficit Hyperactivity Disorder (ADHD; Strum, Fennell, & Gillberg, 2004; Hattori et al., 2006), such as impulsivity, which are frequently seen among individuals with autism. This impulsivity would make it very difficult for an individual to inhibit responding to the distracter arrows of the incompatible stimuli in order to respond correctly. It would be interesting in the future to examine whether or not group differences on the number of errors committed and slowing on incompatible trials exist between children with autism who are receiving psychopharmacological treatment

for symptoms of ADHD versus those who are not, in order to examine the hypothesis that impulsivity is responsible for the group differences.

Comorbid anxiety and depression are also quite common among individuals with HFA (Ghaziuddin, Weidmer, & Ghaziuddin, 1998). It is possible that temperamental differences, such as the group differences in Negative Affectivity found in the current study, begin in infancy or early childhood and set the stage for the development of symptoms of anxiety and depression later in life. One study found that at 12 months old, infant siblings of children with autism who were themselves later diagnosed with autism, exhibited more frequent and intense distress reactions to stimuli, and at 24 months exhibited less expression of pleasure compared with typically developing infants and infant siblings of children with autism who were not later diagnosed with autism (Zwaigenbaum et al., 2005). Similarly, a group of two- to four-year-old children with autism were rated as having a more difficult temperament compared with children with Down syndrome and typically developing children (Kasari & Sigman, 1997). Hence, it appears as if these early temperamental differences continue into adolescence and make the development of comorbid anxiety and depression more likely for individuals with autism than for other groups of individuals.

Lastly, contrary to hypotheses, *Positive Friendship Perceptions* did not mediate the relations between *Approach/Withdrawal*, symptom presentation, and *Social Skills*, due to a lack of predictive relations between *Approach/Withdrawal* and symptoms and *Social Skills*. However, group differences in friendship perception were found, such that the individuals with HFA reported less positive perceptions than the control group. This result is not surprising given that research has found that children with autism are less

likely to endorse companionship, affection, and intimacy, three areas assessed by the NRI and FQS, as being aspects of their definition of friendship compared with typically developing children (Bauminger & Kasari, 2000).

However, post-hoc analyses indicated that more *Positive Friendship Perceptions* were predictive of lower symptom levels across all individuals. This finding may be interpreted in two ways. First, it suggests that individuals who perceive their relationship with their best friend to be more positive (e.g., supportive, affectionate, close, reliable) may feel more confident in themselves or may be more willing to use their friendship as a supportive base in order to engage more readily in their social world. This engagement may offer individuals with HFA the opportunity to learn more appropriate behaviors and learn from the feedback they are given by others in order to decrease their symptoms. Research has shown that peer-mediated interventions, such as training typically developing peers to initiate social interactions with children with autism (Owen-DeSchryver, Carr, Cale, & Blakeley-Smith, 2008), and the formation of peer networks, such as forming a group of autistic and typically developing children to tutor younger students (Kamps, Dugan, Potucek, & Collins, 1999), have been shown to not only improve the social interactions of children with autism, but also increase the social initiations made towards the children with autism by typically developing children. Hence, research has demonstrated that it is, in part, the forging of friendships with typically developing peers that allows children with autism to learn more adaptive behavior. In the current study, many of the children with HFA reported on friendships with a peer who was also diagnosed with a developmental disability. Hence, the results of the current study suggest that it is not only friendships with typically developing peers,

but also with peers who have a developmental disability that encourage positive outcomes. Future research is needed to determine whether or not the relation between friendship perceptions and outcomes varies depending on the diagnostic group of the child's self-identified best friend. In addition, future research can extend the current literature by obtaining information, through parent-report or observational measures, regarding the reciprocity of participants' friendships. Previous research has suggested that deficits in intersubjectivity, empathy, and prosocial behaviors make the development of reciprocal relationships difficult (Hobson, Chidambi, Lee, & Meyer, 2006; Tager-Flusberg, 2001). Hence, for individuals with HFA, it is likely that their perceptions of their friendships do not reflect the social reciprocity typically found in friendships. On many occasions during data collection, parents of children with HFA would comment on the poor quality of their child's friendships, which was not reflected in the child's own self-report. For example, one mother reported that her child's friends took advantage of her child without the child's awareness. In the future, it would be interesting to obtain parent-report of the quantity and quality of their child's friendships or to invite participants to bring their best-friend to the lab in order to obtain observational measures of the quality and reciprocity of the friendship.

A second explanation for the relationship between friendship perceptions and symptom presentation also exists. It is possible that due to the simultaneous collection of the friendship and symptom measures, the relation between *Positive Friendship Perceptions* and symptom presentation may be better explained by lower symptom levels predicting better friendship perceptions. Low symptom levels may enable individuals with HFA to act more appropriately when in the company of peers and hence, enable

them to form more positive peer relationships. Future research will be needed to separate the measurement of symptoms and friendship quality in time in order to truly explore the direction of the predictive relation.

Limitations and Additional Future Directions

There were several limitations of the current study. First of all, the study included relatively small sample sizes. With a larger sample, in the future, it may be possible to detect stronger between and within group differences, and specifically test the interaction between predictors, such as *Approach/Withdrawal* and *Effortful Control* leading to stronger predictions of outcomes among the diagnostic groups. Second, concurrent assessments of self-reported friendship factors and parent-reported symptoms were conducted. In addition, observational ratings of *Social Self-Monitoring* and *Approach/Withdrawal* were obtained at the same time and in the same general context as ratings of *Social Skills*. Future research should separate the assessment of friendship and symptoms in time as well as develop additional observational measures to allow for the measurement of *Social Skills* to be obtained after *Social Self-Monitoring* and *Approach/Withdrawal*, to theoretically support predictive analyses. Third, regarding the Teaching Task used to create the *Social Self-Monitoring* Dyad Factor, the participants from the HFA group were always asked to take on the role as the ‘teacher’ first to ensure they were not influenced by their peer. However, in arranging the task in this way there were numerous instances in which it was clear that the participant from the control group was emulating the teaching behaviors of their peer. Hence, in future research it would be necessary to counterbalance the order of which participant in the dyad is the ‘teacher’

first. Fourth, while this study extended previous research by using a novel observational measure in addition to self- and parent-report measures, future research should continue to expand the use of assessment methods to employ multi-method assessments of temperament, friendship, symptomatology, and social skills. Fifth, employing multiple control groups, including those with elevations in anxiety, depression, and ADHD, would allow for testing whether or not the current findings were the result of commonly comorbid conditions in the HFA group, or if the findings are related to the core symptoms of autism. Lastly, future research should attempt to replicate these findings with individuals with autism of different age ranges and developmental levels to determine if the results are specific to individuals with HFA who are in their adolescence or if the results are applicable to all individuals with an autism spectrum disorder.

Conclusion

All individuals who are diagnosed with autism exhibit deficits in social and communication skills, and exhibit restricted repetitive behaviors. Very few of these individuals ever lose the diagnosis of an autism spectrum disorder over their lifetime. However, the adaptive life outcomes achieved by individuals with autism are extremely varied, even beyond what would be expected based on intellectual functioning (Sigman & Ruskin, 1999). Hence, it is clear that symptomatology alone does not provide enough information to predict day-to-day functioning. The modifier model of HFA (Mundy, Henderson, Inge, & Coman, 2007) suggests that studying non-syndrome specific constructs from the developmental and social neuroscience literatures, which vary among all individuals regardless of diagnosis, provides insight into the processes by which some

individuals with HFA succeed in leading independent lives while others require constant care and supervision. If these factors that influence outcome can be identified, interventions may be developed to target these factors in order to encourage more adaptive functioning.

The current study began to test this modifier model of HFA using a novel observational measure to examine children's social behaviors in a semi-naturalistic context. This is one of the few studies to use observational measures of social behavior as an outcome assessment, while also collecting information regarding temperament, symptoms, and social-emotional functioning, through parent- and self-report measures, to examine individual variability in outcome. The sole use of measures of symptom presentation and other questionnaire assessment methods in research imposes limits upon the conclusions that can be drawn about day-to-day functioning for individuals with autism.

One of the most salient findings of the current study indicated that while *Effortful Control*, composed of self-report and observational measures, did not aid in the prediction of parent-reported symptomatology, it was predictive of adaptive social skills observed during a social interaction. These results suggest that if treatments could be developed to improve *Effortful Control*, subsequent gains in children's adaptive social skills may result.

Clearly, more research using observational measures is needed in order to continue to identify the mechanisms responsible for the diverse outcomes seen among individuals with HFA. Interventions that are designed only to decrease symptoms may not be enhancing the global adjustment or adaptive functioning necessary to ensure

lifelong success. Semi-naturalistic observations, like the one developed for this study, will aid in designing novel interventions to increase adaptive functioning and encourage real-world success in the social and vocational domains for individuals with HFA.

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Table 1a
Correlation Table of Dyad Interaction Measures Across All Participants

	<i>Approach/Withdrawal</i>		
	1	2	3
1. Total Time Talking	-		
2. Number of Shares	.80**	-	
3. Number of Suggestions during Team Task	.50**	.36**	-
	<i>Social Self-Monitoring</i>		
	1	2	3
	4		
1. Number of Looks at Peer	-		
2. Number of Verbal Directives	.47**	-	
3. Number of Shows	.40**	.67**	-
4. Global Teaching Efficacy	.66**	.63**	.60**
	<i>Social Skills</i>		
	1	2	3
	4		
1. Global Eye Contact	-		
2. Global Conversational Efficacy	.63**	-	
3. Global Appropriateness during Get to Know You	.78**	.82**	-
4. Global Appropriateness during Team Task	.72**	.59**	.75**

*trend, *p<.05, **p<.01

Table 1b
Correlation Table of Dyad Interaction Measures Separately by Group

	<i>Approach/Withdrawal</i>		
	1	2	3
1. Total Time Talking	-		
2. Number of Shares	.83**	.68**	-
3. Number of Suggestions during <i>Team Task</i>	.55**	.48**	.52*
		.23	-
<i>Social Self-Monitoring</i>			
	1	2	3
1. Number of Looks at Peer	-		
2. Number of Verbal Directives	.53**	.42*	-
3. Number of Shows	.18	.58**	.72**
4. Global Teaching Efficacy	.67*	.63**	.61**
		.57**	.61**
<i>Social Skills</i>			
	1	2	3
1. Global Eye Contact	-		
2. Global Conversational Efficacy	.65**	.60**	-
3. Global Appropriateness during <i>Get to Know You</i>	.75**	.69**	.79**
4. Global Appropriateness during <i>Team Task</i>	.69**	.39*	.49**
		.80**	.64**
			.79**

Correlations for the control group given in Bold *trend, **p < .05, ***p < .01

Table 2a
Correlation Table of Dyad Interaction Factor Scores Across All participants

	1	2	3
1. <i>Approach/Withdrawal Dyad Factor</i>	-		
2. <i>Social Self-Monitoring Dyad Factor</i>	.17	-	
3. <i>Social Skills Dyad Factor</i>	.11	.30*	-

*trend, *p<.05, **p<.01

Table 2b
Correlation Table of Dyad Interaction Factor Scores by Group

	1	2	3
1. <i>Approach/Withdrawal Dyad Factor</i>	-		
2. <i>Social Self-Monitoring Dyad Factor</i>	.17	.28	
3. <i>Social Skills Dyad Factor</i>	.28	.40*	.25 .34*

Correlations for the control group given in Bold* trend, * $p < .05$, ** $p < .01$

Table 3a
Correlation Table of Response Monitoring Variables Across All Participants

	1	2	3	4
1. <i>ERN at Pz</i>	-			
2. <i>ERN at FCz</i>	.94**	-		
3. <i>Slowing After an Error</i>	-.13	-.17	-	
4. <i>Slowing on Incompatible Trials</i>	.05	-.02	.19	-

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

Table 3b
Correlation Table of Response Monitoring Variables by Group

	1	2	3	4
1. <i>ERN at Fz</i>	-			
2. <i>ERN at FCz</i>	.90**	.97**		
3. <i>Slowing After an Error</i>	.16	-.37	.12	-.40
4. <i>Slowing on Incompatible Trials</i>	.05	.08	-.12	.47* .07

Correlations for the control group given in Bold trend, * $p < .05$, ** $p < .01$

Table 4a
Correlation Table of Dyad Interaction Factors and Related
Indices Across All Participants

<i>Approach/Withdrawal Dyad Factor</i>	
EATQ Surge-ry Factor	-.21
EATQ Surge-ry Scale	-.16
EATQ Shyness Scale	.16
EATQ Fear Scale	.10
<i>Social Self-Monitoring Dyad Factor</i>	
EATQ Effortful Control Factor	.27*
Flanker Number of Errors	-.05
Flanker Slowing on Incompatible Trials	.14
Flanker Slowing on Trial After Error	.21
ERN Amplitude	.17
<i>Social Skills Dyad Factor</i>	
BASC Social Skills Parent-Report	.16
BASC Social Stress Self-Report	-.30*
BASC Interpersonal Relations Self-Report	.25 [†]

[†]trend, * $p < .05$, ** $p < .01$

Table 4b
Correlation Table of Dyad Interaction Factors and Related Indices by Group

<i>Approach/Withdrawal Dyad Factor</i>	
EATQ Surgency Factor	-.19 -.07
EATQ Surgency Scale	-.22 .15
EATQ Shyness Scale	.14 .15
EATQ Fear Scale	.03 .08
<i>Social Self-Monitoring Dyad Factor</i>	
EATQ Effortful Control Factor	.28 .23
Flanker Number of Errors	-.05 .05
Flanker Slowing on Incompatible Trials	.21 -.01
Flanker Slowing on Trial After Error	.27 .21
ERN Amplitude	.22 .13
<i>Social Skills Dyad Factor</i>	
BASC Social Skills Parent-Report	-.36 .19
BASC Social Stress Self-Report	-.17 .07
BASC Interpersonal Relations Self-Report	.10 .01

Correlations for the control group given in Bold* trend, $p < .05$, ** $p < .01$

Table 5a
 Correlation Table of Positive Peer Relationship Scales from NRI Across All Participants

	1	2	3	4	5	6	7	8
1. Companionship	-							
2. Instrumental Aid	.78	-						
3. Intimacy	.70	.85	-					
4. Nurture	.71	.77	.66	-				
5. Affection	.71	.71	.63	.68	-			
6. Admiration	.70	.73	.62	.68	.78	-		
7. Reliable Alliance	.68	.66	.63	.67	.73	.72	-	
8. Social Support	.87	.91	.85	.85	.87	.87	.84	-

All correlations were significant at the level of $p < .01$

Table 5b
 Correlation Table of Positive Peer Relationship Scales from NRI Separately by
 Diagnostic Group

	1	2	3	4	5	6	7	8
1. Comparisonship	-							
2. Instrumental Aid	.73	-						
3. Intimacy	.67	.87	-					
4. Nurture	.72	.76	.68	-				
5. Affection	.75	.64	.75	.52	.69	-		
6. Admiration	.76	.67	.83	.59	.67	.64	.73	-
7. Reliable Alliance	.68	.62	.54	.66	.69	.61	.71	.72
8. Social Support	.88	.83	.88	.93	.82	.93	.85	.87
						.88	.88	.84
							.81	-

Correlations for the control group given in Bold. All correlations were significant at the level of $p < .01$

Table 6a
Correlation Table of Positive Peer Relationship Scales from FQS Across All Participants

	1	2	3	4	5
1. Companionship	-				
2. Balance	.43	-			
3. Help	.72	.43	-		
4. Security	.60	.58	.81	-	
5. Closeness	.59	.71	.66	.78	-

All correlations were significant at the level of $p < .01$

Table 6b
 Correlation Table of Positive Peer Relationship Scales from FQS Separately by Group

	1	2	3	4	5
1. Companionship	-				
2. Balance	.52**	.26			
3. Help	.69**	.51**	.19		
4. Security	.57**	.44*	.76**	.85**	
5. Closeness	.51**	.62**	.87**	.52**	.89**
				.76**	.78**
					-

Correlations for the control group given in Bold *trend, $p < .05$, ** $p < .01$

Table 7a
 Correlation Table of Positive Friendship Perceptions for NRI, FQS, and LSDQ Across All Participants

	1	2	3
1. NRI	-		
2. FQS	.30*	-	
3. LSDQ	-.19	-.08	-

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

Table 7b
 Correlation Table of Positive Friendship Perceptions for NRI, FQS, and LSDQ By Group

	1	2	3
1. NRI	-		
2. FQS	.48**	-	
3. LSDQ	-.04	-.14	.07

Correlations for the control group given in Bold * trend, * p < .05, ** p < .01

Table 8
Hierarchical Regression Analyses Predicting Social Skills

Step and Variable	B	SE B	β	R ² Change	F Change
Step 1 Group	-.71	.19	-.46	.30	23.44**
Step 2 Approach/Withdrawal	.03	.16	.03	.002	.19
Step 3 Effortful Control	.11	.17	.10	.06	4.91*
Step 4 Group X Approach/Withdrawal	-.23	.23	-.18	.01	.75
Step 5 Group X Effortful Control	.32	.24	.22	.02	1.85
Step 1 Group	-.77	.22	-.52	.29	17.38**
Step 2 Approach/Withdrawal	.02	.19	.02	.01	.57
Step 3 ERN Amplitude	-.02	.02	-.22	.00	.23
Step 4 Group X Approach/Withdrawal	-.25	.29	-.16	.03	1.89
Step 5 Group X ERN Amplitude	.04	.03	.25	.04	2.12

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

Table 9
Hierarchical Regression Analyses Predicting ASSQ

Step and Variable	B	SEB	β	R ² Change	F Change
Step 1 Group	20.54	1.95	.83	.76	162.05**
Step 2 Approach/Withdrawal	.92	1.88	.06	.01	1.10
Step 3 Effortful Control	-1.81	1.83	-.11	.00	.55
Step 4 Group X	.65	2.35	.03	.00	.16
Step 5 Approach/Withdrawal Group X Effortful Control	1.73	2.44	.08	.00	.51
Step 1 Group	23.14	2.40	.91	.76	120.87**
Step 2 Approach/Withdrawal	-.47	2.31	-.03	.00	.03
Step 3 ERN Amplitude	.09	.17	.06	.01	1.92
Step 4 Group X	-1.10	3.09	-.04	.00	.45
Step 5 Approach/Withdrawal Group X ERN Amplitude	-.78	.27	-.29	.04	8.14**

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

Table 10
 Hierarchical Regressions Investigating Evidence to Examine Mediation Models with
 Two Criterion: Social Skills and Symptoms

Step and Variable	B	SE B	β	R ² Change	F Change
<i>Social Skills</i>					
Step 1	-.81	.19	-.53	.30	23.44**
Group					
Step 2	.04	.17	.04	.00	.19
Approach/Withdrawal					
Step 3	-.17	.23	-.12	.01	.50
Group X					
Approach/Withdrawal					
<i>ASSQ</i>					
Step 1	21.05	1.85	.85	.76	162.05**
Group					
Step 2	.47	1.80	.03	.00	1.10
Approach/Withdrawal					
Step 3	1.09	2.28	.06	.00	.23
Group X					
Approach/Withdrawal					

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

Table 11a
Correlation Table for Intercorrelation of Measures of Anxiety Across All Participants

	1	2	3	4	5	6
1. BASC Anxiety Parent-Report	-					
2. BASC Anxiety Self-Report	.45**	-				
3. SASC Social Avoidance and Distress-Specific	.31*	.72**	-			
4. SASC Social Avoidance and Distress-General	.34*	.63**	.78**	-		
5. SASC Fear of Negative Evaluation	.25*	.50**	.70**	.67**	-	
6. SASC Total Score	.33*	.68**	.91**	.90**	.88**	-

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

Table 11b
Correlation Table for Intercorrelation of Measures of Anxiety by Group

	1	2	3	4	5	6
1. BASC Anxiety Parent-Report	-					
2. BASC Anxiety Self-Report	.21	.52**				
3. SASC Social Avoidance and Distress-Specific	.15	.16	.80**	.42*		
4. SASC Social Avoidance and Distress-General	.32	-.08	.68**	.25	.78**	.69**
5. SASC Fear of Negative Evaluation	.28	-.02	.55**	.22	.66**	.69**
6. SASC Total Score	.29	.02	.76**	.33*	.91**	.91**

Correlations for the control group given in Bold + trend, * $p < .05$, ** $p < .01$

Table 12
 Correlation Table for Measures of Anxiety with Approach/Withdrawal
 and Effortful Control

	Anxiety Factor
Across All Participants	
<i>Approach/Withdrawal</i>	.36**
<i>Effortful Control</i>	-.16
HFA Group	
<i>Approach/Withdrawal</i>	.26
<i>Effortful Control</i>	-.12
Control Group	
<i>Approach/Withdrawal</i>	.18
<i>Effortful Control</i>	-.04

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

Table 13
 Post Hoc Hierarchical Regression Analysis Predicting Anxiety

Step and Variable	B	SE B	β	R ² Change	F Change
Step 1 Group	.75	.19	.47	.30	23.97**
Step 2 Approach/Withdrawal	.14	.17	.14	.04	2.98*
Step 3 Social Self-Monitoring	-.05	.18	-.04	.01	.70
Step 4 Group X Approach/Withdrawal	.12	.23	.09	.00	.23
Step 5 Group X Social Self- Monitoring	-.11	.25	-.07	.00	.17

*trend, *p<.05, **p<.01

Table 14
Correlation Table for Positive Friendship Perceptions,
Dyad Factors, and Outcomes

Positive Friendship Perceptions	
Across All Participants	
<i>Approach/Withdrawal</i>	-.19
<i>Effortful Control Factor</i>	.03
<i>Social Skills Factor</i>	.10
ASSQ	-.38**
HFA Group	
<i>Approach/Withdrawal</i>	-.20
<i>Effortful Control Factor</i>	-.10
<i>Social Skills Factor</i>	-.21
ASSQ	-.33*
Control Group	
<i>Approach/Withdrawal</i>	-.01
<i>Effortful Control Factor</i>	.10
<i>Social Skills Factor</i>	.30
ASSQ	-.33

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

Table 15
 Post Hoc Hierarchical Regression Analysis Predicting ASSQ

Step and Variable	B	SEB	β	R ² Change	F Change
Step 1 Group	20.61	1.70	.83	.76	162.05**
Step 2 <i>Positive Friendship Perceptions</i>	-2.03	1.70	-.14	.03	6.14*
Step 4 <i>Group X Positive Friendship Perceptions</i>	-.68	2.11	-.04	.00	.10

*trend, *p<.05, **p<.01

Figures.

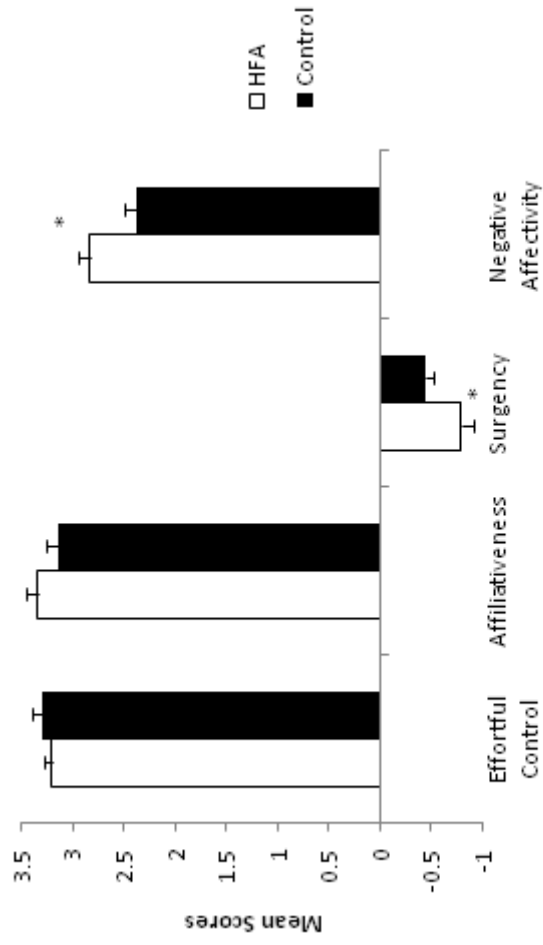


Figure 1. Mean scores on self-report of temperament (+SE).

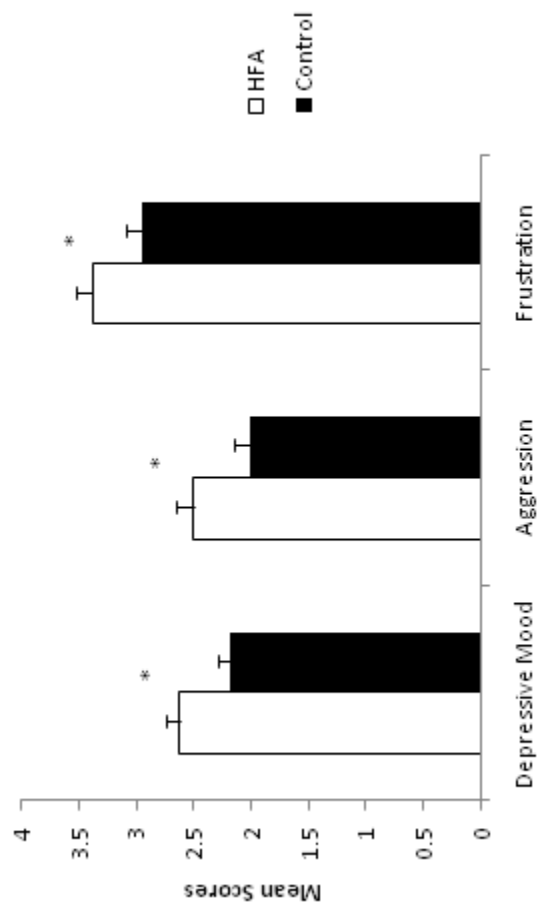


Figure 2. Mean scores on dimensions composing Negative Affectivity (\pm SE).

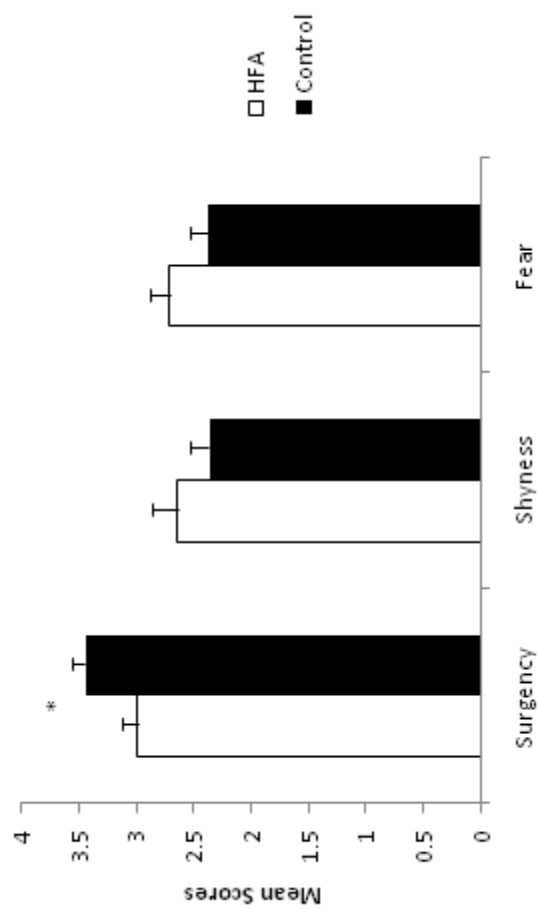


Figure 3. Mean scores on dimensions composing Surgency (+SE).

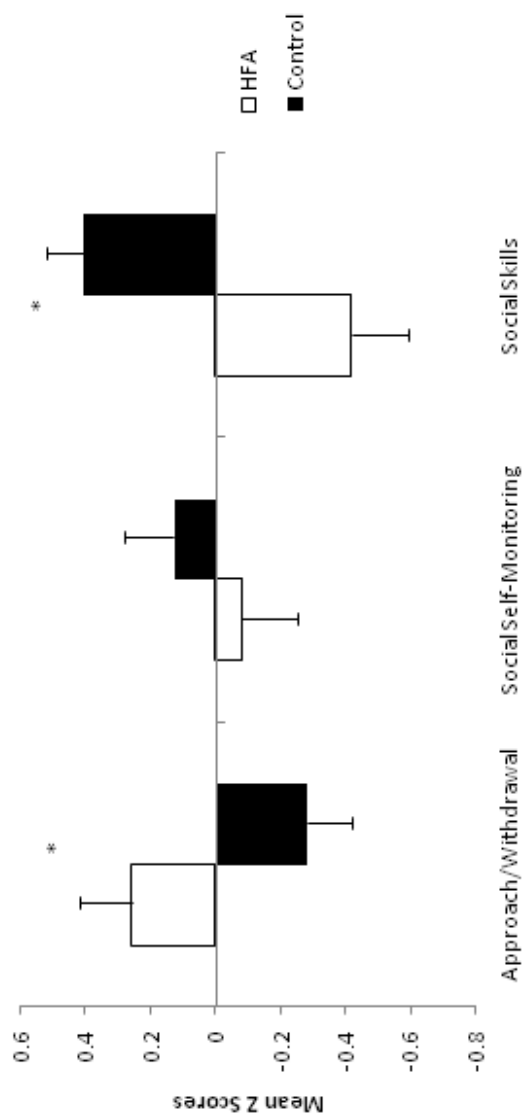


Figure 4. Mean scores on Dyad Factors (+SE).

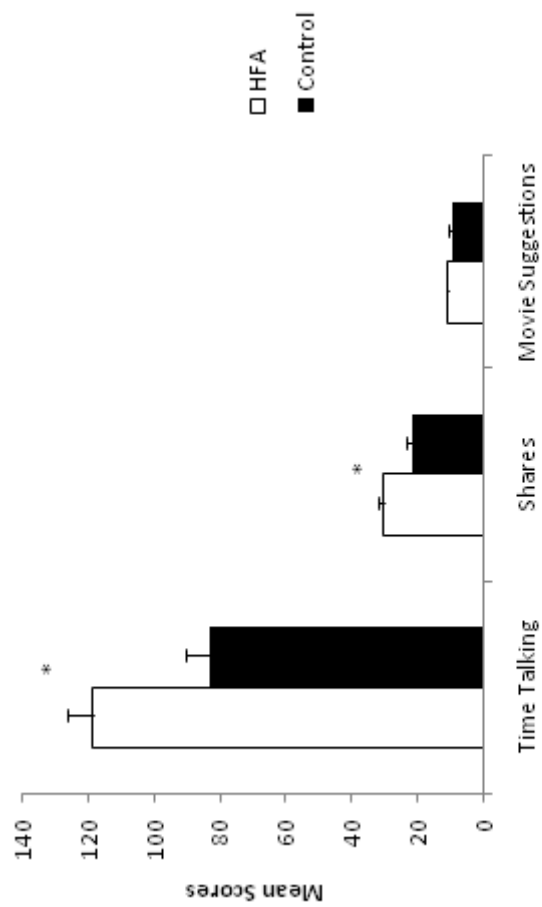


Figure 5. Mean scores on variables composing Approach/Withdrawal Dyad Factor (+SE).

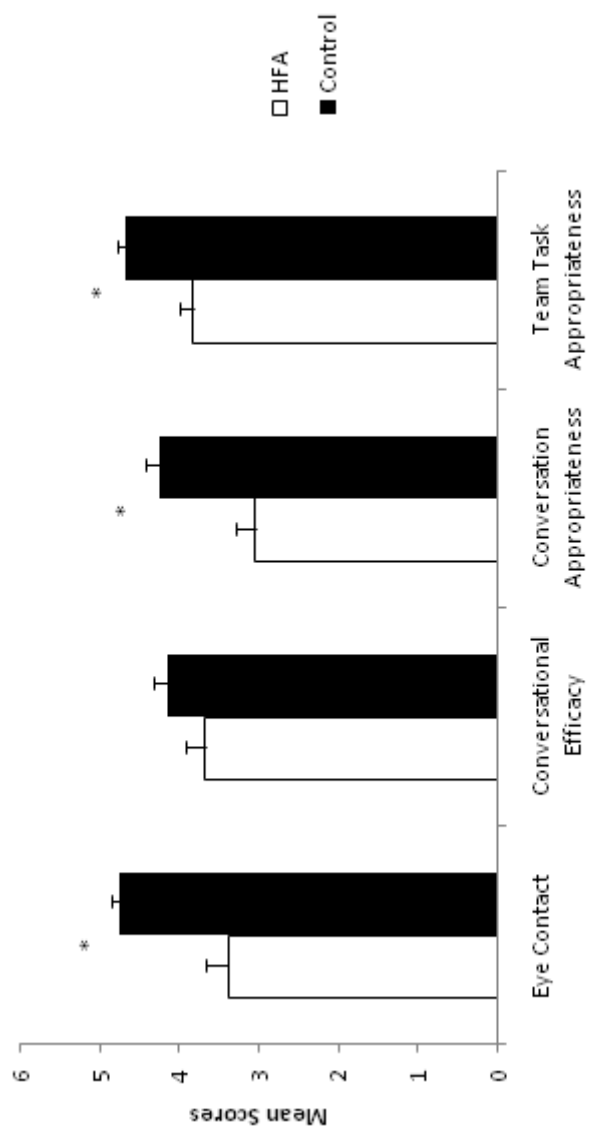


Figure 6. Mean scores on variables composing Social Skills Dyad Factor (+SE).

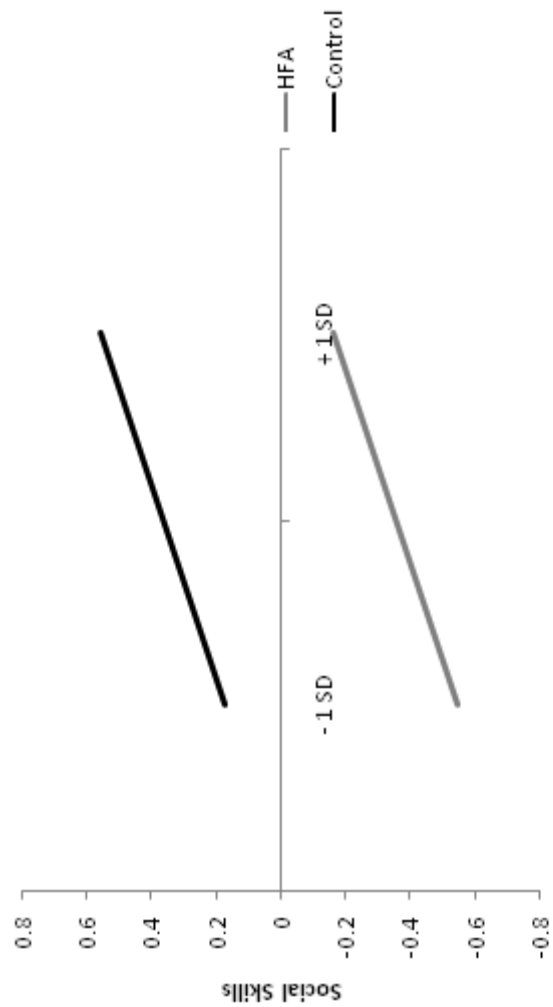


Figure 7. Plot of regression main effects of group and Effortful Control predicting Social Skills.

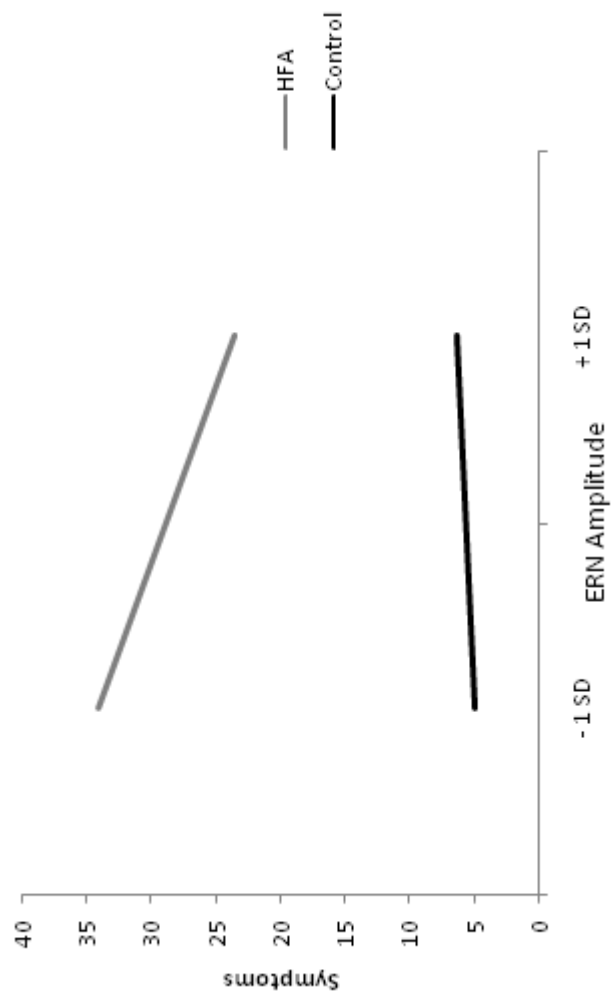


Figure 8. Plot of regression interaction between ERN and Symptom Presentation predicting Symptoms.

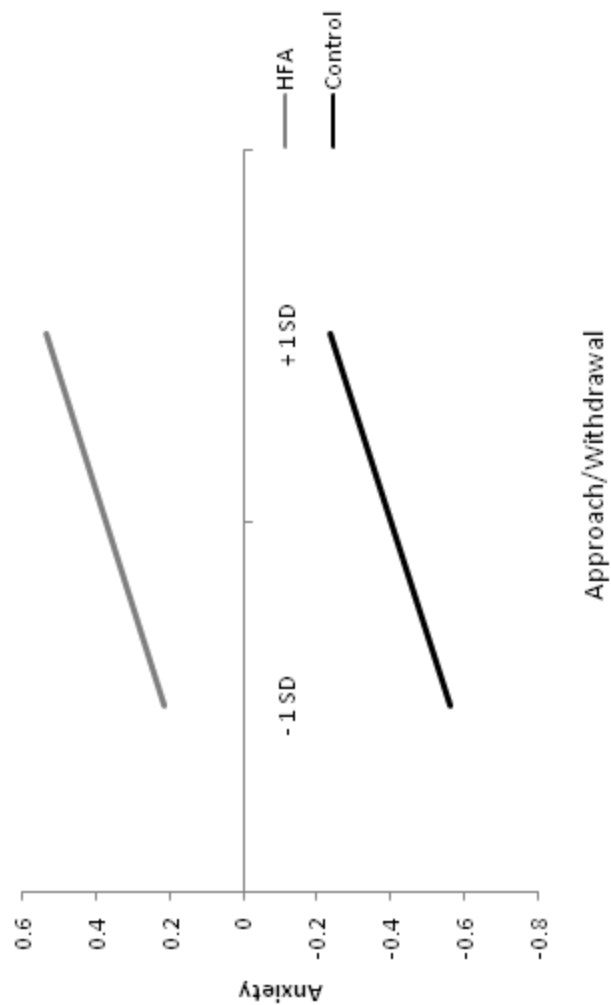


Figure 9. Plot of regression main effects of group and Approach/Withdrawal predicting Anxiety.

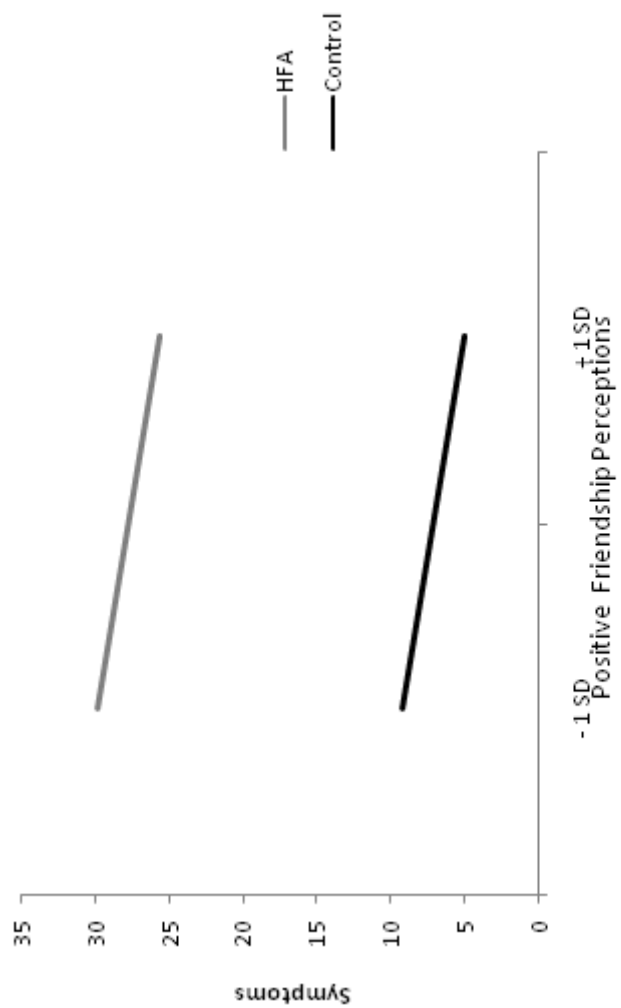


Figure 10. Plot of regression main effects of group and Positive Friendship Perceptions predicting Symptoms.