Social cognitive abilities and social functioning in children with Asperger's Disorder: A comparison with Attention Deficit/Hyperactivity Disorder

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Abstract

Social cognition and social functioning in children with Asperger's Disorder: A comparison with Attention Deficit/Hyperactivity Disorder

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Objective: The current literature has linked the ability to understand one's own mental states with theory of mind, inferring another's mental states. It is suggested that children with Asperger's Disorder (AS) are delayed in the acquisition of social cognitive abilities (Baron-Cohen, 1989, 1991), which may relate to social behavior (Baron-Cohen, 1985, 1991). Other children with social deficits, such as those with Attention Deficit/Hyperactivity Disorder (ADHD), demonstrate poor social functioning due to performance deficits and not deficits in underlying social cognitive abilities (see Landau & Moore, 1991). This research investigated the relationship between social cognitive abilities and social functioning and attempted to demonstrate a link between social cognitive abilities and social functioning in children with AS. Method: Children with AS and ADHD (7-12 years) were recruited from a private practice; typically developing children were recruited by participant referral and advertisements. Children completed the Mind in the Eyes Child Version and a two-subtest WASI, if needed. Parents completed the Vineland Adaptive Behavior Scale –II Socialization Domain, the Social Skills Rating System (SSRS), and the Behavior Rating Inventory of Executive Function (BRIEF) parent report. Demographic information was also collected. Results: Children with AS demonstrated poorer Mind in the Eyes performance and social functioning

overall, followed by children with ADHD and typically developing children. Findings of poorer performance on the Mind of the Eyes task in children with AS compared to children with ADHD approached significance. Children with AS displayed significant deficits in areas of interpersonal relationships and play and leisure skills, but demonstrated similar coping skills as children with ADHD. Both ADHD and AS groups performed more poorly than controls on measures of social functioning. Conclusions: Results do not support a relationship between social functioning and mental state attribution. It is suggestive of an overlap in the type of social deficits experienced by children with AS and ADHD. This research adds to the research on mental state attribution for children with AS and ADHD and has implications for those conducting social skills training with children, as there may be a need to include methods for generalizing social skills related to mental state attribution.

1. Introduction and Literature Review

The Development of Social Functioning

Research has delineated a typical developmental path of social cognition that begins before the age of two years and continues throughout early adolescence. The ability to look in the direction of another's pointing or gazing along with the ability to infer another's mental states have been demonstrated as abilities that must exist before one is able to mentally attribute (i.e. to tell what another person is thinking or feeling). Previous research has suggested that there may be a link between social cognitive abilities and social functioning in some populations. Children with psychological diagnoses can be at risk for experiencing deficits in social behavior or social functioning (i.e. the way a child performs in a social environment). Impaired social functioning has been an associated feature of children diagnosed with ADHD, Learning Disorders, Autistic Spectrum Disorders, Language Disorders, and Anxiety Disorders, for example (APA 1994). Children with Asperger's Disorder (AS) are delayed in the acquisition of abilities needed for the recognition of false beliefs, the understanding of emotions and cognitions in others, the ability to recognize social *faux pas* (Baron-Cohen, 1989, 1991, 1999), and also, by definition, impaired in social functioning. Yet, other children with social functioning deficits, such as those with Attention Deficit/Hyperactivity Disorder (ADHD), are thought to demonstrate poor social functioning due to performance deficits and not deficits in the underlying social cognitive abilities or social skills (see Landau & Moore, 1991). Therefore, the contributing factor to the social problems shown by children with these diagnoses may be different, just as the nature of the social deficit is most likely different.

Social Behavior in Children with Autistic Spectrum Disorders. Deficits in social functioning (APA, 1994; Klin, Volkmar, & Sparrow, 1992) and social interactions (Baron-Cohen, 1985,1989; Hale & Tager-Flusberg, 2005; Happe, 2003) are some of the defining characteristics of an Autistic Spectrum Disorder. Klin and colleagues (1992) investigated the social deficits found in persons with Autistic Disorder (AD) by looking at adaptive functioning. The authors used the Socialization Domain of the Vineland Adaptive Behavior Scales Survey Form, which is the most frequently used measure of adaptive functioning (Luiselli et al., 2001). Klin, Volkmar, and Sparrow (1992) tested the scale's ability to differentiate people with AD from typically developing controls. Nine questions were found to correlate with a diagnosis of AD, six of which were reported to occur before the age of 8 months. Children with AS and AD tend to show more deficient scores on the Socialization domain compared to other areas of adaptive functioning on the Vineland Adaptive Behavior Scale (Volkmar & Klin, 2000).

It has also been shown that children with AS show exaggerated social behaviors, while children with Autistic Disorder appear withdrawn (Volkmar et al., 1982). For example, children with AD may not converse with others. Children with AS, however, can be verbose about a topic of restricted interest, and conversations are typically one-sided. Parents of children with AS have reported concerns relating to their children's conversational skills, social-emotional reciprocity, and peer relationships (Knott et al., 2006). For example, vocal patterns in children with AS may be affected including odd prosody, rate, and volume of speech (Volkmar & Klin, 2000). In addition, children with AS may be interested in acquiring a relationship (i.e. a girlfriend or friend) but have difficulties contacting and maintaining relationships with peers (Volkmar & Klin, 2000).

Children with AS report difficulties with social engagement and anger management as well as problems with social competence that impact peer relationships (Knott et al., 2006).

Studies of social cognition in those with AD or AS include research on self-recognition, self-awareness, recognizing emotions and cognitions in others, and belief attribution. It has been suggested that social cognition may be necessary for appropriate social functioning (Timler, 2003), and therefore much of the research in social functioning and social cognition has been conducted in children with Autistic Spectrum Disorders. Social cognition may be a developmental process that predicts ratings on the socialization questions (i.e., the "road map" to social interactions [Timler, 2003]), and it is social cognition that is delayed in children with AS and AD (Baron-Cohen, 1991).

Development of Social Cognition

Brune and Brune-Cohrs (2006), described a developmental model of social cognition in the following way, "Just as an infant is not capable of jumping before sitting, standing, and walking, the ability of appreciating one's own and other's mental states follows a distinct sequence...(p. 4) (summarized in Figure 1). " Infants gradually develop the ability to understand intent, display joint attention, and gaze in the direction in which another is looking before the age of 18 months. Around 5-8 months of age, infants are observed to look longer when an object changes direction from a path implying intention (i.e. moving towards a hole in a box seemingly to remove itself from the box) rather than just changing physical direction (i.e. moving randomly around the screen) demonstrating an understanding of intent. In other words, it is inferred that infants at this age can predict the future action of an object (see Saxe et al., 2004 for review). At the age of 6 months,

healthy infants begin to differentiate between animate and inanimate objects, and later in the first year they begin to display joint attention, or the ability to look in the direction another person is looking (Bates et al., 1975; Brune & Brune-Cohrs, 2006). Directional gaze (i.e. looking in the direction in which another is looking) requires an understanding of intent and may be a developmental achievement required for social cognition (Hale & Tager-Flusberg, 2005). Following directional gaze is the ability to track a person's pointing, which develops around 14 to 18 months (see Saxe et al., 2004 for review).

Studies have shown that 42% of typically developing infants under 18 months of age and 63% of infants ages 18-20 months of age showed self-recognition (Amsterdam, 1972). Self-awareness, the ability to recognize one's own mental states, is an ability that must exist before the ability to mentally attribute (Gallup 1982, 1998). Therefore, once one is aware of him or herself and then understands that he or she possesses cognitions and emotional states, one can entertain the possibility that others have similar states. Self awareness has traditionally been measured by analyzing the capacity to identify oneself in a mirror (Gallup, 1982, 1998, 2003; Platek et al., 2004; Platek & Levin, 2004). Typical tasks involve measuring self-referential or mirror directed behavior. Self-awareness, therefore, can be seen as a stepping stone toward complex social cognition.

Children develop some of the first signs of mental state attribution, a higher level social cognitive ability, following the development of self-recognition, around the age of 24 months (Brune & Brune-Cohrs, 2006) along with the development of pretend play (Leslie, 1987). Researchers have studied pretend play by measuring a child's ability to participate in feeding himself and a doll, placing a telephone receiver up to his and a doll's ear, and taking a drink and giving one to the doll (Lewis & Ramsay, 2004).

Children are also able to recognize the preferences of an investigator (i.e. hand the investigator his or her preferred food instead of the child's preferred food) by the age of 2 years (Repacholi & Gopnik 1997).

At about 4-6 years of age, children typically master the ability to recognize their own and other's mental states (Baron-Cohen et al., 1985; Baron-Cohen, 1991; Brune & Brune-Cohrs, 2006; Sodian et al., 2003; Wimmer & Perner, 1983). Children begin to recognize that other people hold beliefs about another's belief (Baron-Cohen, 1989), and recognize the emotions and thoughts of others, which has been shown to develop around the age of 5-6 years (see Brune & Brune-Cohrs 2006 for a review). Children can begin to use this skill to deceive or misrepresent themselves around the same time (Wimmer & Perner, 1983). At approximately 7 years of age, children are beginning to understand how to modify their speech so as not to offend others, as measured by a *faux pas* task (Baron-Cohen et al., 1999).

Mental state attribution was first described as belief attribution by Wimmer and Perner (1983). Baron-Cohen (1989) further delineated the development of belief attribution by describing a first and second order. The first order belief attribution can be thought of as the ability to acknowledge that another has a belief (Wimmer & Perner, 1983). Leslie (1987) refers to first order belief as "meta-representation" (i.e. the ability to understand that one has mental states), or, knowing that someone else thinks. Researchers have used tasks such as short stories depicting beliefs by characters that are incorrect (Wimmer & Perner, 1983) or the Sally and Anne false belief task to measure first order belief attribution (Wimmer and Perner, 1985).

Second order attribution was defined as the understanding that a person has a belief about another's beliefs. For example, Sue *thinks* Bob thinks that he will meet with Judy in the library after class. Second order cognition requires taking into account that the ability to understand that others have mental states similar to your own enabling the prediction of actions based on that understanding. Tasks such as the "Ice-Cream Van" story (Perner & Wimmer, 1985) , which will be reviewed in a later section, have been used to measure second order belief attribution. It may be possible, therefore, that possessing advanced belief attribution enables one to predict others' behavior based on knowledge of their beliefs (Baron-Cohen 1985; Bowler, 1992) or to use deception to manipulate beliefs (Gallup, 1997; Wimmer & Perner, 1983). For instance, perhaps Judy asks Sue to tell her boyfriend Bob that she will not be able to meet him at the library. Sue, who has mastered the skill of belief attribution, can recognize that Bob thinks that Judy will meet him in the library unless Sue tells him otherwise. Sue knows, however, that Judy will not be there. Therefore, Sue decides to go to meet Bob. Sue was not only able to predict Bob's action, but she was able to manipulate events to meet her goal of meeting Bob alone.

The literature on social cognition suggests that second order belief attribution (i.e. understanding that someone has beliefs about another's beliefs) may be correlated with social functioning. For example, Leppanen and Hietanen (2001) found that healthy school-age children (7-10 years of age) were least accurate at recognizing surprise and fear, two emotions that require an advanced understanding of another person's beliefs. These researchers also found that the understanding of surprise was significantly related to social competence and peer popularity in females. Hale and Tager-Flusberg (2005)

conducted a longitudinal study of social communication in children with social deficits as they related to second order belief attribution skills. After controlling for intelligence scores and language, the researchers found that second order belief attribution contributed significantly to scores on contingent discourse (i.e. maintaining the topic of conversation). The same results were found approximately one year later, even with a significant increase in contingent discourse. Performance on social cognition tasks, therefore, correlated with the number of "on topic" utterances in conversations.

The literature has clearly established a developmental process of social cognitive development beginning with the recognition of animate vs. inanimate objects, joint attention, directional gazing, self recognition, and pretend play during the first 2 years of life. Following these abilities, first order belief attribution (i.e. the understanding of false beliefs) and second order belief attribution (i.e. the ability to have beliefs about other's beliefs) develops. There have been many tasks developed to measure complex levels of social cognition; however, research has just begun to demonstrate a link between social cognitive abilities and social functioning. Most researchers use tasks such as the false belief tasks (Baron-Cohen, 1991; Baron-Cohen et al., 1985; Perner et al., 1989; Wimmer & Perner, 1983), social stories (Baron-Cohen, 1989; Bowler, 1992; Sabbagh, 2004), the *faux pas* task (Baron-Cohen et al., 1999), and most recently, the Mind in the Eyes Test-Revised (Baron-Cohen et al., 2001) to measure social cognition.

Tasks measuring Social Cognition

"Sally and Anne" False Belief Task (Wimmer & Perner, 1985). One of the original false belief tasks was developed by Wimmer and Perner (1985). The "Sally and Anne" task employed two dolls named Sally and Anne, and children were asked to determine

where each doll would look for a hidden marble. The subject was first asked to name the dolls. Then, the doll named Sally placed a marble in a container and left the room. Following this, Anne changed the location of the marble while Sally was gone. When Sally returned, the subject was then asked, "Where will Sally look for her marble?" Performance on the task was measured as pass/fail. Also included were some control questions to confirm that the child was able to recall information such as, "Where was the marble in the beginning?" There has been no thorough investigation of the psychometric properties of this task, and studies have suggested the need for future research in the area (Mayes et al., 2006).

Baron-Cohen and colleagues (1985) conducted a study using this task including children with High Functioning Autism (HFA) (ages 6-16), Down Syndrome (ages 6-17), and typically developing children (ages 3-5). The results showed that 20% of children with AD passed the "Sally and Anne" task compared to 85% of children with Down's syndrome and 86% of typically developing children. The children with HFA tended to pick the location in which the marble was actually located instead of the place that Sally thought it was. More recently, Colle, Baron-Cohen, and Hill (2007) used a non-verbal false belief test in an effort to separate children with speech and language impairments from children with AD. This research was conducted to address concerns regarding the intense load on language skills required for the traditional false belief test. The researchers documented impairment in theory of mind in children with AD independent of language abilities. The decrease in performance on the "Sally and Anne" task in children with HFA is consistent with previous literature which suggests a delay in theory

of mind abilities. While the "Sally and Anne" task measures first order belief attribution, the "Ice-cream Van" story was developed to analyze second order belief attribution.

"Ice-Cream Van" story (Perner & Wimmer, 1985). The "Ice-Cream Van" story used by Perner and Wimmer (1985), Baron-Cohen (1989) and Bowler (1992) is an example of a social story designed to assess theory of mind. It is a story about John and Mary who have a miscommunication about the location of an ice cream truck. At the end of the story, Mary thinks John has gone to buy ice cream from a truck that was originally in one place but has now moved to another. The implication is that Mary will now look for John at the original location of the truck. This task has a number of "prompt questions" intended to control for attention and understanding of the story. The results from Baron-Cohen's study (1989), which utilized participants with AD (ages 10-18), Down Syndrome (ages 9-17), and typically developing controls (age 7), suggest that children with AD may have a simple or first order theory of mind, as measured by the ability to pass a first order belief attribution task, but have difficulty with more advanced tasks. This was supported by the fact that 9 out of 10 participants with AD were unable to correctly point to the location Mary would think the truck would be located. Studies with similar stories have found that typically developing children demonstrate this ability around the age of 6 years (Wimmer & Perner 1983).

While the "Ice Cream Van" story was developed to measure second order belief attribution, researchers became interested in expanding the investigation of social cognitive abilities in order to further understand the complexities of abilities necessary for social interactions. Happe's strange stories (Happe, 1994) were developed to measure

the more advanced ability of mental state attribution or understanding what another person is thinking or feeling.

Happe's "strange stories" (Happe, 1994). Happe's strange stories (1994) were designed to assess children's understanding of characters' thoughts and feelings. The task consists of 24 short stories that require mental state attribution for comprehension. There are two examples of different situations in which mental state attribution is needed. The first situations include jokes, misunderstandings, and lies, while the second investigates figures of speech. The task, when used by Jolliffe and Baron-Cohen (1999) who found that those with AD and AS made significantly more incorrect mental state justifications than typically developing controls. A recent replication of Happe's "strange stories" also showed that children with AS of normal intelligence (i.e. IQ of >85) showed deficits in appropriately using mental state terms (Kaland et al., 2005).

"Mind in the Eyes Test" (Baron-Cohen et al., 1997). A recent test designed to measure mental state attribution in adults, the "Mind in the Eyes Test," was originally developed by Baron-Cohen and colleagues (1997). The test consists of displays of emotion as depicted by window slot pictures of people's eyes (see Figure 2). It is comprised of 25, two-word, forced-choice items that are emotional opposites (e.g. concerned and unconcerned, or noticing someone else and noticing you). The emotions depicted are not simple emotions such as happy or sad, and instead focus on more "complex" mental states that may require a sophisticated theory of mind.

Baron-Cohen and colleagues (1997) researched the ability of this test to differentiate theory of mind performance by including adult participants with HFA, Tourette's Sydrome, and typically developing controls. They found that the group of

participants with Tourette's Syndrome and the typical control subjects performed significantly better than participants with HFA. The researchers also found a sex difference suggesting that females performed significantly better than males on this test. There is only one documented attempt made to measure the construct validity of this task. Investigators noted similarly poorer performance of children with HFA compared to children with Tourette's Syndrome when given both the Mind in the Eyes Test and Happe's "strange stories." Happe's "strange stories" were given to participants as part of a separate study, however, and the tasks were not directly compared (Baron-Cohen et al., 1997).

In recent modifications to the "Eyes" test, Baron-Cohen and colleagues (2001) revised the test to include 36 items and a 4-word forced choice format instead of 2-word (see Figure 2). The word choices were modified to increase the difficulty of the test and to avoid ceiling effects. Instead of choices like "interested" and "disinterested" (Baron-Cohen et al., 1997), the choices provided descriptions such as, "playful, comforting, arrogant, and hateful." The researchers suggested that the addition of choices introduces ambiguity to the test requiring the use of an advanced ability to mentally attribute. A children's version of the test was also developed by Baron-Cohen and colleagues (2001).

Baron-Cohen and colleagues (2001b) found that children with no diagnosis scored significantly higher on the Mind in the Eyes test at ages 8-10 years of age *(* $\bar{x}$ = 18.1*, SD* = 4.7, n = 8*)* and ages 10-12 years *(* $\bar{x}$ = 20.2*, SD* = 2.4, n = 9*)* than children with AS ages 8-14 years *(* $\bar{x}$ = 12.6*, SD* = 3.3, n = 15*)*. This suggested an effect for age as well as diagnosis on performance on this task. It is also important to note that the researchers

controlled for attention to the eyes by asking participants to indicate the gender of the person in the pictures.

Faux Pas Task (Baron-Cohen et al., 1999) - More recently, Baron-Cohen and colleagues (1999) developed an advanced social cognition task focused on the detection of a *faux pas*. Aimed at the 9 to11 year old age range, the test is comprised of 10 stories in which a character commits a faux pas. The authors define faux pas as, "…when a speaker says something without considering if it is something that the listener might not have wanted to hear or know, and which typically has negative consequences that the speaker never intended" (p. 408). Committing a faux pas tends to result in feelings of regret or embarrassment and is hypothesized to require (1) an understanding that there is a difference in the knowledge of the characters and (2) an appreciation of the emotion of the situation (Baron-Cohen et al., 1999). The following is an example of a faux pas story:

> Steve, a scientist, is traveling on a plane with his wife. Suddenly, he is tapped on the shoulder by another scientist. Steve looks up, sees that he knows this man, and says, "Oh hi! How nice to run into you! Let me introduce you to my wife, Betsy. Betsy, this is Jeffrey, a good friend of mine from Harvard days." Betsy says, "Oh, hi Jeffrey, pleased to meet you." The other man replies, "Er, my name isn't Jeffrey, it's Mike," (p. 408).

Male children ages 9 and older have been shown to perform above chance on this task with 80% accuracy by age 11 years (Baron-Cohen et al., 1999).

Social Cognition of Children on the Autistic Spectrum

AD and AS are pervasive developmental disorders characterized by severe impairments in social functioning including conversation skills and reciprocal social

interactions (APA, 1994). Children with AS or AD have been shown to be delayed in the acquisition of social cognitive abilities (Baron-Cohen, 1989, 1991; Charman et al., 1997; Happe, 2003). Baron-Cohen and colleagues (1985), using the Mind in the Eyes task, showed that children with HFA have a deficit in the ability to mentally attribute. Levin Allen (2008) similarly found that 8 year old children with AS demonstrated poorer recognition of emotions and cognitions of others when compared to typically developing siblings of children on the Autistic Spectrum. Leekam and Perner (1991) have documented that 4 year-old children with AD also performed significantly worse than typically developing 4-year-old children at a false photograph task (i.e. a task where the photograph presented does not properly represent an actual real-world environment).

In emotion recognition research, persons with AD have the most difficulty recognizing surprise, which requires knowledge of the beliefs of others that differ from your own, as opposed to angry, happy, sad, neutral, or "just ok" (Loveland et al., 1997). This is consistent with Baron-Cohen's supposition (1985, 1991) that people with AD should have difficulty with second order belief attribution, as surprise requires a more advanced understanding of another's emotions. Heerey et al. (2003) found that self-conscious emotions, such as embarrassment, were linked to theory of mind ability independent of intelligence in 8-15 year old children with HFA. These children often identified embarrassed as "happy," implying a lack of understanding of the emotion.

Social Cognition and Social Functioning in children with AS. The current literature suggests that deficits in social cognition (Baron-Cohen & Frith 1985, Baron-Cohen 1991) and social functioning (APA, 1994; Baron-Cohen, 1989, 1985; Hale & Tager-Flusberg, 2005; Happe, 2003; Klin, Volkmar, & Sparrow 1992) may exist

independent of one another for children with AS. In particular, the deficits have been shown in children with AS in the areas of social interactions (Hale & Tager-Flusberg, 2005) and understanding of others' emotions (Heerey et al., 2003). Research on interventions for children with AS have demonstrated improvements in recognizing the emotions of others (Solomen et al., 2004), companionship abilities and sharing (Bauminger, 2007), as well as overall social functioning (Lopata et al., 2008) in social skills groups that include teaching children how to understand and recognize the emotions of others.

A recent study (Levin Allen, thesis) found that the ability to recognize another's emotions and cognitions was significantly related to play and leisure skills for 8 year old children with AS as well as siblings of children with autistic spectrum diagnoses. Children with AS also performed significantly lower than unaffected siblings. This association was not found for children ages 9-13 years in either group, suggesting that the social development of children with AS, between the ages of 8 and 9 years of age, may be negatively affected by late mastery of the capacity for reading complex emotional and cognitive mental states of others.

Six to eight year old children begin to develop a desire to be liked and accepted by others while 9-11 year old children are emotionally invested in forming stronger more complex peer relationships (CDCP, 2005; CDCP, 2005b). By the age of 9, it is possible that children begin to recognize that a child with AS does not participate in peer interactions in similar ways as others. While other children are beginning to use higher order social cognition to manipulate others and/or predict other's actions, children with AS may have just mastered first or second order belief attribution. This research suggests

that there may be an important relationship between the development of social cognition (i.e. the age at which this knowledge emerges) and performance or application of the abilities in a social environment (i.e. social functioning) that should be further explored.

Summary and Rationale

For this study, social competence/functioning is conceptualized as reflecting three separate domains: social abilities, social skills, and social performance. Social abilities are the underlying knowledge necessary for social interactions often labeled social cognition. Social skills can be thought of as the way in which one uses his or her social knowledge. Social performance is a measure of a child's social functioning in a social environment. In other words, whether a child is good at using his abilities and skills in a social arena (LeGoff, personal communication). The majority of the work in the area of social cognition in children with AS has focused on analyzing the deficits in abilities purportedly needed to perform socially. The current approach, although useful and informative, has only just started to connect "social functioning" to "social cognition."

The delay in the development of social abilities or cognition may be related to abnormal social behavior or performance in participants with AD independent of general cognitive ability (Baron-Cohen, 1985, 1991) and language comprehension (Perner et al., 1989). Although the literature on social cognition in children with AS has demonstrated that a deficit exists beyond that which can be explained by neuropsychological deficits, there is still some controversy in the field (Saxe et al., 2004). Research has shown deficits in executive functioning in children with ADHD and AS (Geurts et al., 2004; see Sergeant et al., 2002 for review) that must be accounted for when interpreting performance on social cognitive tasks to ensure that deficits in executive functioning do

not account for the variability in performance on social cognitive tasks. Previous studies have cited the lack of testing for executive functioning (i.e. problem solving skills or inhibition) and cognitive abilities (i.e. IQ testing) as limitations (Levin Allen 2008; see Saxe et al., 2004 for review) in interpreting finding in social cognition research. It is important, therefore, to include measures of executive functioning skills to ensure an appropriate level of cognitive ability when using social cognitive tasks.

Social Cognition of Children with ADHD. Social cognitive abilities have been shown to be deficient in some children who have social deficits (i.e. children with AD or AS), while social cognitive abilities in others with social difficulties, such as children with Attention Deficit/Hyperactivity Disorder (ADHD) have not been as well researched (Nijmeijer et al., 2008). It has been suggested that it is important to include a control group of children with psychological conditions that impact social functioning when investigating social cognition in children with AS (Buitelaar et al., 1999).

One study of children with various psychiatric conditions found evidence to suggest that children with psychiatric conditions, ADHD in particular, perform more poorly than typically developing children on tasks of second order belief attribution (Buitelaar et al., 1999). It should be noted, however, that these results were based on only nine children, mostly male, with ADHD who were compared with a control group that was predominately female.

A more recent study by Downs and Smith (2004) of children ages 5 to 9 years (mean around age 8 years) found that children with AD performed significantly worse at identifying emotional facial expressions in photographs than children with ADHD and Oppositional Defiant Disorder (ODD) or nonclinical children. There were no significant

differences between groups (i.e. children with AD, ADHD/ODD, and nonclinical controls) on children's performance when asked to identify emotional facial expressions in schematic drawings, identifying situation-based emotions (e.g. how will Johnny feel when x happens), identifying desire-based emotions (e.g. what does Johnny want and how will he feel when x happens…), and identifying belief-based emotions (e.g. this is what Johnny wants and this is what Johnny thinks, Johnny doesn't know x, what will Johnny feel when x happens). Although children seemed to perform more poorly overall, there was no difference between groups, when asked to identify belief-based emotions, a complex task measuring the knowledge that someone has a thought that differs from another as well as the emotions that person has based on his belief. Children with ADHD/ODD answered significantly fewer questions correct on the emotional understanding tasks overall than nonclinical children, while children with AS showed a trend toward the same finding. In general, the differences between children with ADHD/ODD and AS on emotional understanding were not fully delineated.

There have been very few studies conducted on the social cognition of children with ADHD. Research regarding the social cognition of children with ADHD should be further explored to determine whether children with ADHD have deficits in this area or if social functioning problems are due to other difficulties such as skill deficits as is currently hypothesized.

Social Functioning in Children with ADHD. Children with ADHD display frequent and severe patterns of inattention and/or hyperactivity-impulsivity before the age of 7 and across two or more settings (e.g. school and home) (DSM, 1994). Children who have problems with inattention and impulsivity may also have difficulties in social

functioning including problems with maintaining conversations (e.g. not listening to others, frequently shifting the conversation, not following the details of the conversation, interrupting others) and peer rejection (DSM, 1994). Generally, children with ADHD have social difficulties that arise from problems in regulating behavior resulting in seemingly aggressive, restless, or intrusive behavior and maintaining attention in conversations or situations (e.g. difficulty switching roles and other conversational difficulties as described above) resulting in peer rejection (see Nijmeijer et al., 2008 for review). Researchers have theorized that impaired social functioning in children with ADHD is most likely due to performance deficits and not skill deficits (see Landau & Moore 1991 for review). In other words, children with ADHD may know how to behave, but often perform inappropriately in social situations. Children with ADHD should, therefore, demonstrate social functioning problems but should not have deficits in social cognition, and will represent an appropriate comparison group.

Purpose

The purpose of this research study is to determine whether performance on a social cognition task is associated with social functioning or parent reported performance in a social environment and whether this association differs between groups.

Research has shown that children with AS display deficits in social cognition (Baron-Cohen & Frith 1985, Baron-Cohen 1991) and social functioning (APA, 1994; Baron-Cohen, 1989, 1985; Hale & Tager-Flusberg, 2005; Happe, 2003; Klin, Volkmar, & Sparrow 1992) independently. Children with ADHD show deficits in social functioning (DSM, 1994; Nijmeijer et al., 2008), however the findings on social cognition (i.e. social abilities) in children with ADHD are less clear (Buitelaar et al.,

1999; Downs & Smith, 2004). It has been suggested that social deficits (i.e. deficits in performance) in children with ADHD result from an overall lack of skill (see Landau & Moore 1991 for review), while children with AS have social deficits that may result from a lack of or difficulty with social cognition (Baron-Cohen et al., 1985). Studies have also just begun to identify a potential link between social cognition and social functioning in children (Levin Allen, 2008). The current study was designed to add to the research on social cognition in children with social deficits, as well as attempt to expand previous work to confirm findings of an association between social cognition and social functioning with a larger sample size and better comparison groups.

Research in the area of social cognition and social functioning has important implications for clinicians working with children deficient in social development, as there are inherent differences in selected interventions and therapeutic effectiveness depending on which abilities are the antecedent to the presenting problems. Finding associations between deficits in abilities and social performance has the potential to maximize the effectiveness of social skills programs. For instance, if a child's behavior problems stem from problems with social cognition, as suggested in children with AS, one would focus on therapies that improve the child's abilities in that area. If a child has intact social cognition, but continues to display poor performance in a social environment, as is suggested for children with ADHD, it is possible that the child lacks social skills and must be taught ways in which to appropriately use their abilities.

Hypotheses

Aim 1: To investigate social cognitive abilities of 7-12 year old children with and without diagnoses that are associated with social functioning deficits, controlling for executive functioning.

Hypothesis 1a: Performance on the Mind in the Eyes task would differ by group such that children with AS would perform poorer than children with ADHD or typically developing controls.

Hypothesis 1b: Performance on the Mind in the Eyes task would differ by age such that performance would improve with age.

Aim 2: To investigate the relationship between development of social cognitive ability and social functioning in children with and without diagnoses associated with social deficits.

Hypothesis 2a: Performance on the Mind in the Eyes task would be associated with social functioning as measured by the Vineland Adaptive Behavior Scale-II Socialization Domain, controlling for group.

Hypothesis 2b: Performance on the Mind in the Eyes task would be associated with social functioning as measured by the Social Skills Rating Scale parent form, controlling for group.

Exploratory Aim: The relationship between performance on the social cognition task and social functioning was explored. An attempt was made to break down children into two groups, those who have mastered the social cognition task and those who fall below the cut-off for mastery.

Hypothesis Ea: Performance on the Mind in the Eyes task would be associated with social functioning as measured by the Vineland Adaptive Behavior Scale-II Socialization Domain in the group who has not mastered the social cognition task only.

Hypothesis Eb: Performance on the Mind in the Eyes task would be associated with social functioning as measured by the Social Skills Rating Scale parent form in the group who has not mastered the social cognition task only.

2. Method

Participant Recruitment

Children with AS. Children with AS were recruited from the Center for Neurological and Neurodevelopmental Health (CNNH) in Voorhees, NJ. Male children, ages 7 through 12 years, diagnosed with AS, using the criteria for AS as defined by the DSM-IV-TR, were included through open enrollment. An Autism Diagnostic Observation Schedule (ADOS) and clinical interview was used for each participant to confirm the diagnosis of AS. Diagnoses were made by professionals who specialized in the area of children with AS.

Children with ADHD. Participants diagnosed with ADHD were also recruited from the Center for Neurological and Neurodevelopmental Health (CNNH) in Voorhees, NJ. Male children, ages 7 through 12 already diagnosed with ADHD as defined by the DSM-IV-TR were included through open enrollment. Diagnosis was not made as part of this investigation but was confirmed as part of the recruitment process by reviewing the DSM-IV TR criteria for each participant to ensure they met criteria for the diagnosis of ADHD.

Typically Developing Children. Typically developing students were recruited in two ways. First, in order to ensure similar socioeconomic status, children were recruited by asking participants in the AS or ADHD group to provide the investigator's contact information to a friend with no known psychological or psychiatric diagnosis who may be willing to participate in the study. Children were also recruited from advertisements, which were placed in the CNNH waiting room and sent out in local newsletters.

The exclusion criteria were as follows. For the AS and ADHD group, (1) participants with a concurrent neurological or psychiatric diagnosis other than ADHD, (2) patients taking psychotropic medication other than medications for ADHD (3) patients with other health issues limiting participation (for example, psychosocial stressors or medical limitations), (4) patients with significant visual impairment or hearing problems, either of which could impact their ability to complete the tests, (5) those who could not respond appropriately to the test due to potential difficulties with understanding the tasks or those with an IQ below 80, and (7) females were excluded to reduce variability in the sample.

For the typically developing control group, the exclusion criteria included all of the above with the following modification to items (1) and (2): (1) participants with concurrent neurological or psychological diagnosis including ADHD or AS were excluded, (2) patients taking psychotropic medications including medications for ADHD were excluded.

Children in the AS or ADHD group were identified by a psychologist based on clinical interactions with them. An eligibility form developed for this study was then used (Appendix 1) to indicate a diagnosis of AS or ADHD and to determine whether a child

met the inclusion/exclusion criteria based on information typically obtained in an initial interview or assessment. Following the completion of the eligibility form and determination of eligibility, names were given to the investigator who then called the family to ensure interest. For all participants, eligibility criteria was provided to the parent over the phone, but was not directly assessed until after the family met with the investigator and signed the consent/assent forms. If the family was interested in the study, the researcher scheduled a time to sign the consent/assent forms, review the inclusion and exclusion criteria, have the parent complete the questionnaires, and have the participant complete the study at the CNNH.

All children who agreed to participate by signing the consent form, whether they are able to complete the tasks or not, were entered into a drawing to receive a gift. The gift was a $40 gift card.

Measures

*Mind in the Eyes Task (*Baron-Cohen et al., 2001b). The child version of the Mind in the Eyes test is composed of 28 pictures of male and female eyes which convey an emotion. The words were presented in a random order to the participant and contained three incorrect or "foil" affect labels and one correct emotional description. Correct and foil terms were piloted by Baron-Cohen and were deemed to be correct if more than half of typically developing children chose the label, and if the second most common label was not chosen by more than a third of the same group of children (Baron-Cohen et al., 2001b). In order to score above chance level, a participant needed to correctly identify the feeling for 9 of the 28 items. The Mind in the Eyes score is cumulative based on total number correct.

The Mind in the Eyes test was described to the child by explaining that he would see pictures and would be asked to respond to those pictures by choosing the best answer from four different words. Words were be both written on the page and read to the participant. The investigator pointed to each word on the sheet as the word was read aloud and participants were asked to point to their response. The exact instructions were as follows: "Each picture has four words around it. I want you to look carefully at the picture and then choose the word that best describes what the person in the picture is thinking or feeling. Let's try a practice. Do you think this person is feeling jealous, scared, relaxed, or hate (the researcher pointed to each word as she stated them)? Pick the word that describes what this person is thinking or feeling." After the practice item, the instructions continue: "You might find some of them quite easy and some of them quite hard, so don't worry if it's not always easy to choose the best word. Please ask me if you're not sure what a word means. I will read the words for you and I will point to the words, so you can read along if you'd like. If you really can't choose the best word, you can have a guess (p. 2)" (Baron-Cohen, 2001c).

Vineland Adaptive Behavior Scale-II (Sparrow et al., 2005). The Vineland Adaptive Behavior Scale, Second Edition, is the most frequently used measure of adaptive functioning (Luiselli et al., 2001). The survey form of the Vineland Adaptive Behavior Scale-II Socialization Scale was administered to the parents of the participants for all groups. Sparrow and Cicchetti (1978), two of the developers of the Vineland scale, found high correlations between primary caregiver and independent assessment of levels of adaptive behavior, suggesting that parents were able to reliably complete the survey.

The Vineland-II contains 433 items divided into five domains: Communication, Daily Living Skills, Socialization, Motor Skills, and Maladaptive Behavior. The current study is focused on the Socialization domain (99 questions), which contained three sub-domains -- Interpersonal Relations (38 questions), Play and Leisure Time (31 questions) and Coping Skills (30 questions). The Interpersonal Relationships sub-domain includes information about responding to others, expressing and recognizing emotions, imitation, friendship, thoughtfulness, belonging to groups, and dating. Play and Leisure Time involves playing, sharing and cooperating, television and radio, hobbies, and going places with friends. Finally, the Coping Skills sub-domain includes questions regarding manners, following rules, apologizing, keeping secrets, controlling impulses, and responsibility.

Parents were instructed that the items on the Socialization Domain should be rated on the following scale: "yes, usually (2)," "sometimes or partially (1)," or "no, never (0)," "don't know (DK)," and "no opportunity (N)." If the parents are unsure of the response, he or she was asked to choose the best answer. Parents were instructed that any skill that their child had mastered during typical development (e.g. turns head toward caregiver) should be rated as a "2." Any skill that a child had not reached or was not old enough to have reached (e.g. attends a full time job) were rated as a "0." The Vineland-II Socialization Domain was derived based on age in order to obtain a standard score (*Mean* = 100, *SD* = 15), and the Vineland-II Interpersonal Relationships, Vineland-II Coping, Vineland-II Play and Leisure Time were also derived based on age in order to obtain a standard V-score (*Mean* = 15, *SD* = 3) with higher scores indicating better functioning. The Vineland-II has demonstrated strong reliability and validity and has shown moderate

correlations with other adaptive behavior inventories more than with intelligence tests which support the construct validity of this scale (Sparrow et al., 2005).

Social Skills Rating System (Gresham & Elliot 1990). The Social Skills Rating System (SSRS) was developed in 1990 to obtain parent, teacher, and child reports of social behavior. The current study focused on the total scale score of the parent scale which contains four subscales (i.e. Cooperation, Assertion, and Self control, Responsibility). The SSRS parent version (SSRS-P) was administered to the parents of the participants for all three groups. Parents were instructed to think about their child's present behavior and decide how often the child performs a behavior and how important each behavior is to the child's development using the scale described above. If the parents were unsure of the response, they were asked to choose the best answer.

The SSRS-P contains 38 items divided into 4 subscales – Cooperation, Assertion, Self Control, and Responsibility. Each subscale consists of 10 items, with 2 questions loading on two factors, that are rated as occurring "never (0)," "sometimes (1)," or "very often (2)" and as "not important (0)," "important (1)," or "critical." A total scale standard score ($\bar{x}$ = 100, *SD* = 15) was obtained. Higher scores indicate better social skills. The SSRS has demonstrated strong reliability and has shown high to moderate correlations with other behavior inventories including the Behavior Assessment System for Children and the Vineland Adaptive Behavior Scale (Van der Oord et al., 2005).

The Wechsler Abbreviated Scale of Intelligence (WASI) – (Wechsler 1999) is a brief and reliable measure of intellectual ability that provides a full-scale IQ score using two subtests, which can be given in about 15 minutes. The WASI contains a 4 subtest and 2 subtest version. This study used in the 2 subtest version, which has been deemed

sufficient when considering time limitations and is useful when using the test as a screening tool for general cognitive functioning. Subtests included the Vocabulary subtest, a measure of verbal knowledge in which children are asked to define words, and the Matrix Reasoning subtest, a measure of nonverbal reasoning in which children are asked to choose the appropriate abstract design from a group of designs. Each subtest results in a T-score ($\bar{x}$ = 50, *SD* = 10) and an overall Full Scale IQ standard score ($\bar{x}$ = 100, *SD* = 15). Higher scores indicate better functioning. The WASI demonstrated high reliability and stability. When compared to other cognitive ability measures such as the WISC-III, the WASI demonstrated good construct validity. It is important to exclude children whose cognitive ability are in the mentally retarded range, which could impact their ability to understand the task presented. For children who were being seen clinically, and were given a WISC-IV as part of their assessment, that IQ was used in place of the WASI to screen for cognitive ability.

Behavior Rating Inventory of Executive Function (BRIEF) (Gioia et al., 2000) – The BRIEF is a questionnaire of executive functioning that has a parent, self, and teacher version. The current study administered the Parent Form and was interested in the Behavioral Regulation and Meta-cognition indexes. The Behavioral Regulation Index includes Inhibiting, Shifting, and Emotional control, and the meta-cognition index includes Initiation, Working Memory, Planning/organizing, Organization of Materials, and Monitoring. The Parent Form has 86 items with ratings of "never (0), sometimes (1), or often (2)." Norms are available for children ages 5-18 years of age. Children with AS have been shown to have greater difficulty with shifting and flexibility than children with

ADHD (see Baron 2004 for review). The BRIEF has demonstrated moderate to high reliability. Convergent and discriminate validity are well established (Gioia et al., 2000).

Procedure

Institutional Review Board approval was obtained from Drexel University for this study. Upon arrival to the CNNH office, the investigator described the tasks to potential participants and consent was obtained from the parent and assent was obtained from the child. Demographic data was collected about the child participants from parents including the following items: age, birth date, race, educational setting, therapies and services, number of siblings, and parent or guardian completing the questionnaires.

Parents were given a packet of questionnaires and asked to complete them in order (i.e. the demographic sheet, BRIEF, Vineland-II Socialization Domain, SSRS). At the same time, each child was escorted to a testing room at the CNNH. Participants in the AS or ADHD group as well as the typically developing children completed the following tasks in order: the Vocabulary and Matrix Reasoning subtests from the Wechsler Abbreviated Scale of Intelligence (WASI) (if an IQ was not previously obtained clinically) and the Mind in the Eyes task.

Data Analysis

Once the data were collected, scored, entered, and checked, a preliminary analysis was conducted to assess the distribution of variables and determine the need for covariates. Demographic variables (i.e. grade and educational setting) were tested as potential correlates on dependent measures (i.e. Vineland-II Socialization and the SSRS total scores) using a Chi Square analysis. see Table 1. The majority of the sample was Caucasian with only one African American child in each of the Asperger's and ADHD

group. Therefore, race was dropped as a potential covariate. Only mothers completed the questionnaires. Next, to ensure that the relationship between the independent and dependent variables was not due to executive functioning deficits, Pearson Correlations were conducted for each group between the social skills scales and the BRIEF. Age was analyzed as part of the hypothesis testing. A t-test was conducted for all continuous demographic variables and a Chi Square was conducted for categorical variables to determine differences between the groups. Significant findings were entered into the analyses as covariates.

A power analysis, conducted using Cohen's (1992) Power Primer for the ANOVA with 3 groups and a medium effect size, indicated that a total of 52 participants per group would be necessary to obtain a power of .80. Previous research has shown an effect size for detecting differences on the Mind in the Eyes test between typically developing children and children with AS to be between .56 and .80 (Baron-Cohen et al., 2001b). Therefore, for a multiple regression with 3 independent estimated variables, using an alpha level of .05, a medium effect size, and a power of .80, a total of 34-76 participants per group was necessary. This study expected to recruit approximately 30 participants per group. Since recruitment was less than expected, an attempt was made to analyze effect sizes and observed power was reviewed as a potential limitation.

Twenty-nine participants consented to the study. One subject was not able to complete the study due to difficulty understanding the tasks on the WASI. Participants in the control group included two siblings of patients currently attending CNNH who saw the advertisement and contacted the investigator. The other two participants saw the advertisement outside of the CNNH and contacted the investigator.

Two subjects' data were removed due to scores that presented as outliers from the rest of the AS group (i.e. scores of 20 or above on the Mind in the Eyes test). One subject was in a regular education setting and had not received any social skills intervention or services. The other child received behavior therapy in the past and was receiving social skills therapy services as well as counseling and psychology services for behavior. Both children had the extremely high scores (i.e. two of the highest among all subjects) on both the BRIEF Meta-cognition and Behavior Regulation subscales. Due to the small sample size, these two subjects were removed in order to better examine the population of children with AS who fell in a more typical range based on previous research. Previous studies have cited a mean of 12.6 (*SD* =3.3) for children with Asperger's Disorder ages 8-14 years. The mean for the AS group in this study was 14.25 (SD = 3.25) without the outliers compared to a mean of 15.14 (SD = 3.76) with the outliers. The remaining group sizes were 12 children with Asperger's Disorder, 10 with ADHD, and 4 typically developing children. Due to the extremely small sample size of the typically developing group, the data was described only and was not used in statistical analysis.

To test Aim 1, Hypothesis 1a, that performance on the social cognitive task would differ by group such that children with AS would perform more poorly than the other groups, a one-tailed t-test was conducted. To test Aim 1, Hypothesis 1b, that performance on the Mind in the Eyes task would improve with age, a bivariate correlation was conducted for the social cognitive measure and age.

To test Aim 2, Hypothesis 2a and 2b, that performance on the social cognitive task would predict with social functioning, a stepwise regression was conducted regressing each social functioning measure (i.e. the Vineland-II Socialization and SSRS

parent) on group and any identified covariates from prior analysis (step 1) as well as the Mind in the Eyes test (step 2).

To test the Exploratory Aim, Hypothesis Ea, that the relationship between performance on the social cognition task and social functioning would depend on level of mastery, age of mastery was defined as the point at which visual analysis of the data indicated no difference between children with Asperger's Disorder and the other two groups. Visual analysis did not reveal this finding, however a frequency analysis revealed a cut-off score of 16 (i.e. approximately 50% - 11 children - scoring less than 16 items correct on the Mind in the Eyes test and approximately 50% - 15 children scoring 16 items or more on the test), which was used to separate the data into two groups (i.e. low and high performance). Partial correlations were then conducted, controlling for group, to determine whether there was an association between the Mind in the Eyes test and the social functioning measures.

3. Results

Group Comparison

Data on educational setting was collected as a descriptive measure of educational placement. Educational setting was analyzed using a Chi Square test and was found to indicate a significant difference between groups $X^2 (4, N=26) = 12.25$, $p = .02$, Grade was also analyzed with a Chi Square revealing no significant differences between groups. All participants had an IQ with a standard score above 80. Two participants, one child with ADHD and one child with AS, had cognitive abilities in the Low Average range. See Table 1 and Figures 3 & 4 for demographic information.

Independent samples t-tests were conducted to examine differences between the AS and ADHD groups for the socialization variables (see Table 2). There was a significant difference between groups on the Vineland-II Socialization Domain, but no difference was found between groups on the SSRS Social Skills Scale. Children with AS had a mean in the Borderline range on the Vineland-II Socialization Domain and in the Low Average range on the SSRS Social Skills Scale, while children with ADHD had scores in the Average range on both measures. However, no statistically significant difference was found. Children in the control group were not included in the analysis, but had mean scores on both social functioning measures in the Superior range.

On the Subscales of the Vineland-II Socialization, t-tests revealed significant differences between the AS and ADHD groups on the Interpersonal relationships and the Play and Leisure Time subscales. No significant differences were found for the Coping Skills subscale. Children with AS scored in the Moderately Low range overall for both the Interpersonal Relationships and the Play and Leisure subscales while children with ADHD performed in the Adequate range overall on both subscales. Typically developing children were not included in the analysis, but were in the Moderately High range for both the Interpersonal Relationships and the Coping Skills scales and in the Adequate range for the Play and Leisure Time subscale (see Table 2).

Preliminary Analyses

Measures

Pearson correlations were conducted to determine the relationship between the standardized scales of social functioning (see Table 3). The Vineland-II measures were significantly associated with the Social Skills Rating Scale total score.

Determination of Covariates

To determine the need for potential covariates in hypotheses testing, the groups were first compared on demographic variables (i.e. grade and placement). Significant a priori group differences were found between groups on educational placement. A multivariate ANOVA was then conducted to determine whether educational placement was significantly related to dependent measures, which was not significant. Therefore, educational placement was not included as a covariate. Next, bivariate correlations were conducted for age and BRIEF variables with all dependent variables (i.e. social functioning measures). Significant relationships were found between the Behavior Regulation subscale of the BRIEF and the Vineland-II Play and Leisure Time subscale as well as the BRIEF Meta-cognition subscale and the SSRS Social Skills scale. All other correlations were not significant. It should be noted that a relationship between age and the Vineland-II scales, SSRS, and the BRIEF subscales was not expected since they are standardized for age. This does suggest, however, that children with ADHD and AS demonstrated raw score improvements keeping their standard scores relatively consistent. The BRIEF Behavior Regulation and Meta-cognition subscales were used as covariates for the dependent variables to which they were significantly related only.

Hypothesis Testing

Hypothesis 1

Hypothesis 1a was that the Mind in the Eyes task would differ by group such that children with AS would perform poorer than children with ADHD or typically developing children. The Mind in the Eyes performance was compared between AS and ADHD groups only, using a one-tailed independent samples t-test. All participants scored

above chance level on the Mind in the Eyes test, and were therefore included in the analyses. The results were significance ($t(20) = -1.92$, $p = .04$), and demonstrated a large effect size. Means for the AS and ADHD group were 14.25 ($SD = 3.25$) and 17.10 ($SD = 3.73$) items correct respectively. Typically developing children were not included in the analysis, but had a mean of 18.25 items correct on the Mind in the Eyes task. This hypothesis was supported (see Table 2).

Hypothesis 1b, that performance on the Mind in the Eyes task would differ by age such that performance would improve with age, was analyzed using a partial correlation controlling for group. Age was significantly related to Mind in the Eyes performance ($r = .70$, $p < .01$). Therefore, this hypothesis was supported (see Table 3 & Figure 5).

Hypothesis 2

Hypothesis 2a was that performance on the Mind in the Eyes task predict social functioning. This hypothesis was tested for the Vineland-II Socialization Domain score using a stepwise regression as described above, which resulted in a model that was significant. Only group was a significant predictor, however and the Mind in the Eyes test was excluded. Therefore, this hypothesis was not supported (see Table 4).

Hypothesis 2b, that performance on the Mind in the Eyes task would be associated with the Social Skills Rating Scale was analyzed using a stepwise regression controlling for BRIEF Meta-cognition, which was identified as a covariate in prior analyses. The overall model was significant, however only the BRIEF Meta-cognition subscale and group were indentified as significant predictors. The Mind in the Eyes variable was excluded. Therefore, this hypothesis was not supported (See Table 4).

Exploratory Analyses

Exploratory Hypotheses

The relationship between performance on the Mind in the Eyes task and social functioning was further explored. After finding that age was significantly related to Mind in the Eyes performance controlling for group, a graphical representation of the relationship between age and Mind in the Eyes performance was reviewed. The visual depiction did not indicate the anticipated findings. A frequency analysis was then used to separate the participants into a low (i.e. less than 16 items correct on the Mind in the Eyes) and high performance (i.e. greater than or equal to 16 items correct) group. Partial correlations were conducted for the low and high performance groups independently associating the Mind in the Eyes performance with all social functioning measures, controlling for group. No significant associations were found. For the AS and ADHD groups, Mind in the Eyes performance did increased with age.

Variables of Interest

In order to further explore the relationship between Mind in the Eyes performance and the social functioning measures, a partial correlation was conducted controlling for group and age. Interaction effects that could more specifically depict the relationship between age, group, Mind in the Eyes performance and social functioning measures (i.e. a multiple regression with main effects and interaction terms) could not be analyzed due to the small sample size. Results of the partial correlations were not significant for the Vineland Socialization Domain, the Vineland Play and Leisure Time subscale, the Vineland Coping Skills subscale, or the SSRS Social Skills scale. The relationship between Mind in the Eyes performance and the Vineland-II Interpersonal Relationships subscale approached significance (r = -.41, p = .07) but was inversely related. In other

words, as performance on the Mind in the Eyes task improved, Vineland-II Interpersonal Relations scores were lower (see Table 5).

4. Discussion

The purpose of this study was to explore whether performance on a mental state attribution task, a measure of social cognition, would predict social performance (i.e. social functioning) as reported by parents. Research has shown that children with AS and ADHD demonstrate social functioning deficits (APA, 1994), and may also perform more poorly than typical children or children with other psychiatric problems on social cognition tasks (Buitelaar et al., 1999). More specifically, children with AS have demonstrated significant deficits in social cognition (Baron-Cohen & Frith 1985, Baron-Cohen 1991), while the research on children with ADHD has been less clear (Buitelaar et al., 1999; Downs & Smith, 2004).

It has been suggested that improvements in social cognition may lead to better social functioning (Timler, 2003), however, most of the research has assumed an empirical relationship because deficits in both areas exist when children have problems with social cognition. In other words, children with AS demonstrate deficits in social cognition as well as social functioning, therefore the assumption is that there must be a causal relationship. This study attempted to show an empirical link between social cognition and social performance using a small sample of two patient populations that have deficits in social functioning, but were hypothesized to have differences in social cognition abilities.

The results of the current study are consistent with previous research and suggests that children with AS have deficits in parent reports of social functioning. Significant

differences between groups were found on the Vineland-II Socialization Domain. Further qualitative exploration revealed that children with AS demonstrated social deficits over and above children with ADHD or typically developing children in the areas of Interpersonal Relationships (i.e. skills such as responding to others, expressing and recognizing emotions, friendship, and belonging to groups) and Play and Leisure skills (i.e. skills such as playing as well as sharing and cooperating) only.

The ADHD and AS groups did not differ on skills such as following rules, using manners, apologizing, keeping secrets, controlling impulses, and responsibility, however. There was also no difference between groups on the Social Skills Rating Scale (SSRS), which includes items similar to the Vineland-II Coping Skills scale such as helping others, sharing, and following instructions, initiating behaviors and responding to others, communicating with adults, showing concern and respect for others' feelings, and responding appropriately to teasing. Both scales that were not significantly different between groups relate to following social norms (e.g. keeping secrets, sharing, and responding appropriately) as well as attention and executive functioning (e.g. initiating and controlling impulses). Scores on the SSRS and the Vineland-II Coping Skills scale were in the Average range for children with ADHD and in the Average to Low Average range for children with AS. A very small group of typically developing children scored in the Superior range for both measures.

This finding suggests that children with AS and ADHD serve as good comparison groups. Both groups have social functioning deficits, but their pattern of problems differs in some areas. It is possible that children with AS and ADHD may overlap in some areas of social functioning, but may differ in areas more related to social cognition such as

interacting and playing with others. The BRIEF Meta-cognition subscale and group explained 50% of the variance in SSRS scores, and it is likely that the overlapping social deficits may be related to problems with attention and/or executive functioning skills.

Both children with AS and ADHD have documented symptoms of significant inattention and over activity (APA, 1994). The DSM-IV-TR (APA, 1994) lists symptoms of over activity and inattention as associated features of AS and prohibits diagnosis of ADHD in this population. The manual does recognize the prevalence of these symptoms in both populations. Taken together, there is a strong argument for attention and executive problems explaining a portion of the overlap in social functioning deficits.

In addition to differences in social functioning, the current study found that differences between the ADHD and AS groups on a social cognition measure was significant. This data also suggested that there is a large effect size for such a small sample. Children with AS generally answered about 14 items correctly while children with ADHD answered about 17 items correct and typical children answered about 18 items correct. Unlike the findings in the area of social functioning, children with ADHD appear to fall somewhere in between typical children and children with AS when analyzing mental state attribution, however more subjects are needed to confirm this finding. This finding adds to previous research, which found a trend for significance when analyzing differences between children with ADHD and typical children in performance on an emotion recognition task (Buitelaar et al., 1999). The results are also similar to a study by Downs and Smith (2004), which found that children with ADHD/ODD answered significantly fewer questions correct on the emotional

understanding tasks overall than nonclinical children, while children with AS showed a trend toward the same finding.

Age was significantly related to performance on the social cognition task, supporting Hypothesis 1b. This finding is consistent with previous studies suggesting that social cognition may improve with age (see Kuusikko et al., 2009 for review; Levin Allen 2008). Due to the limited sample size of this study, further exploration of age and mental state attribution or emotion recognition could not be delineated.

Contrary to predictions, no relationship was found between performance on the Mind in the Eyes test and measures of social functioning, therefore hypothesis 2 was not supported. Exploratory analysis even revealed a trend toward significance suggesting that Mind in the Eyes performance was inversely related to the Vineland-II Interpersonal Relationships subscale. This finding was unexpected, but may highlight an important point by Bauminger (2002) who suggested that understanding people's mental states is only partially understood in children with autism and, "this knowledge is not spontaneously translated into daily social interactions with peers." In other words, it is possible that it is not the ability to label or recognize another's emotion that relates to social functioning, but instead the understanding or practice of what to do with that knowledge (i.e. social skills) that can predict social performance. The finding of a weak, negative relationship between performance on the Mind in the Eyes task and the Vineland-II Interpersonal Relationship scores may also be consistent with research that has found that children with AS have difficulty generalizing skills related to emotion recognition (Bauminger 2002; Rao et al., 2008). Although this may be a spurious finding, it may also be that children who begin to master the ability to mentally attribute are at a

loss or even are frustrated by their inability to translate the knowledge into skills that would increase their social performance.

Limitations

The results of this study are limited by the following factors. First, the sample size (12 children with AS, 10 children with ADHD, and 4 typically developing children) was inadequate to detect a relationship should it have existed. The lack of statistical power also restricted analysis of interaction effects within the current sample. This resulted in The lack of significant findings for the hypotheses may be due to the size and characteristics of the sample, which may not have adequately represented the general population of those with AS. For example, this study did not contain any female participants and subjects were generally recruited from families with upper-middle class income levels. In addition, 2 subjects were removed due to performance on the Mind in the Eyes task that was extreme compared to the rest of the AS group. With a larger group size, differences in performance could have been further explored. Because of these factors, these results may not generalize to the entire population of those with AS.

Our recruitment method may have also limited the generalization of our findings. Due to restrictions in locations for advertisements as well as methods of contacting children and families, our study population was primarily recruited from families spending significant amounts of time in the CNNH waiting room. Because families tended to stay and wait for their children to complete a social skills group, they became the group most likely to view our advertisement. As a result, more than half of the children in the AS and ADHD groups were participants in the social skills groups provided by the CNNH. Although this limits the variability in the current sample,

therefore removing the potentially confounding variable of whether or not a child received social skills intervention, it does restrict the ability to generalize the results to the general population. Given that many children with ADHD either do not participate in social skills groups, or participate in social skills groups focused on attention and executive related skills, this similarity across groups may have resulted in less variability overall, therefore limiting our results.

The lack of objective neuropsychological testing is also a limitation. Although a parent report measure of executive functioning was given to provide a day to day, functional measure of executive skills, the behavior report did not analyze problem solving skills, inhibition, or impulsivity objectively. It is possible that deficits in these skills may have had a negative impact on children's ability to accurately complete the Mind in the Eyes task. Similarly, it is possible that natural neurological development of executive skills, rather than improvement in social cognition is related to social functioning. Research has shown consistent growth in white matter with age as well as increases in gray matter in the frontal lobe that peaks around the age of puberty (i.e. age 12 for males) (Giedd et al., 1999). It is possible, therefore, that neurological development rather than improvements in social cognition is related to improvements in social functioning.

Educational setting as well as our method of analyzing social functioning may also be limiting factors. Although the current study did not find a relationship between educational setting and parent report measures of social functioning, it is possible that an appropriate social setting influenced parents' view of social performance. In other words, parents may be rating social functioning based on the way in which children interact with

peers who were similarly delayed rather than typically developing peers. A recent literature review (Rao et al., 2008) cited the lack of informed raters as a limitation in appropriately measuring social functioning. Future studies should consider including multiple informants to obtain a better understanding of social functioning in school or with peers.

In addition, a number of studies on social skills interventions have not found significant changes following intervention using the SSRS or other social performance ratings as outcome measures, while other, more objective measures of social performance have improved (see Rao et al., 2008 for review). For example, one study found significant improvement in behavioral observation of play sessions as well as self-perceived social support from classmates following a social skills intervention, however findings were not significant on pre and post SSRS ratings (Barry et al., 2003). Future research should focus on developing methods for quantifying social interactions with peers in real-word environments. This would shed further light on the relationship between emotion recognition and social functioning and eliminate the need to use parent and/or teacher reports.

Finally, the validity of the Mind in the Eyes test could be a limitation. There is little research and norms available for the measure. Although the test does demonstrate a predictive value for diagnosis based on the current study (i.e. children with AS perform more poorly than children with ADHD or controls), it is possible that the test is measuring something other than social cognition. The current study also found that both group and BRIEF Meta-cognition scores predicted social functioning, whereas the Mind in the Eyes task did not. This finding supports the suggestion that executive skills may

impact performance on the Mind in the Eyes task and not purely deficits in social cognitive abilities. Future research should consider the impact of executive skills when assessing social cognition.

Implications

This research has implications, although limited, for both clinical practice and future research in the area of social development in children with AS. The finding of a possible inverse relationship between mental state attribution and social functioning is important when considering the generalization of social skills training. Whereas some studies focus purely on training in emotion recognition, clinicians may want to consider adding training on how to interact with others once an emotion is recognized into their social skills interventions. For example, children with AS could be taught to acknowledge another child's feelings (i.e. active listening) and ask what he or she can do to help should a child with AS recognize that someone is frustrated or upset. Previous literature has suggested that training programs should include teaching social behavior in addition to social cognitive abilities (Ozonoff & Miller, 1995).

In terms of research implications, this study adds to the research of emotion recognition, specifically labeling facial expressions using eyes, in a pediatric population of children with AS and ADHD. This study is one of only a few studies to include children with ADHD, and one of two studies to analyze the relationship between children with ADHD and AS specifically. While this study did have limited subjects, it is similar to the prior study, which included only 9 ADHD participants.

Future research needs to be conducted with a larger sample size to investigate the hypothesized relationships, as well as to demonstrate the reliability and validity of the

Mind in the Eyes task. While removing the limitation of measurement error, this would also provide norms for clinical application. This research also has the potential to generate hypotheses for future investigations. Future research should, for example, look at the understanding of what to do or how to respond to someone when one recognizes the emotions of others in addition to a child's proficiency in emotion recognition in general.

Summary and Conclusions

Overall, the results of the current study do not support a relationship between social functioning and emotion and cognition recognition. The findings do suggest that children with AS and ADHD may have different social functioning in the areas of interpersonal skills and play and leisure skills and similar performance in the area of coping skills. It is possible that children with AS have problems in social functioning that relate to attention and/or executive functioning skills in addition to deficits related more to social cognitive abilities. The current study also suggests that future research should consider the importance of the generalization of the social skills related to the ability to recognize the emotions and cognitions of others.

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Appendix A. Figures

Table 1: Demographic information

Demographic Variables	AS	ADHD	Typicals
Gender %, *(n)*			
Male	100% (12)	100% (10)	100% (4)
Age			
M (SD)	120.83 (17.26)	107.3 (12.55)	117.50 (21.69)
Grade			
M (SD)	3.83 (1.64)	3.20 (1.14)	3.50 (2.08)
Race %, *(n)*			
Caucasian	92% (11)	90% (9)	100% (4)
African American	8% (1)	10% (1)	
Educational Setting %, *(n)*			
Regular Education	0% (0)	50% (5)	100% (4)
Regular Education with pull out services	8% (1)	30% (3)	
Regular Education with 1:1 Aide	42% (5)	10% (1)	
Special Education	42% (5)	10% (1)	
Home Schooled	8% (1)	0% (0)	
IQ %, *(n)*			
Low Average	8% (1)	10% (1)	
Average	84% (10)	30% (3)	50% (2)
High Average	0% (0)	40% (4)	
Superior/ Very Superior	8% (1)	30% (3)	50% (2)

M = mean
SD = standard deviation
n = number of participants
% = percentage

Table 2: Descriptive Statistics and t-tests for children with AS, ADHD, and Typicals on variables of interest (NOTE: Typicals not included in analysis)

Variables (Type of Score)	Asperger's Disorder $\bar{x}$ (SD)	ADHD Controls $\bar{x}$ (SD)	Typicals	*t (df)*	*p*	effect size Cohen's *d*
Vineland-II Socialization (Standard Score)	79.17 (11.75)	97.20 (19.12)	**121 (8.52)**	-2.71 (20)	.013	-1.14
Vineland-II Interpersonal Relationships (V-Score)	10.25 (2.45)	14.50 (3.23)	**18 (.82)**	-3.64 (20)	.002	-1.54
Vineland-II Coping (V-Score)	13.25 (2.18)	14.10 (3.45)	**19 (1.63)**	-.70 (20)	.490	-0.29
Vineland-II Play and Leisure Time (V-Score)	10 (2.52)	14.30 (3.47)	**17.25 (1.71)**	-3.37 (20)	.003	0.72
Social Skills Rating Scale (Standard Score)	84.17 (17.60)	96.10 (21.21)	**127.50 (5)**	-1.44 (20)	.164	-0.61
*Mind in the Eyes (Total Correct)	14.25 (3.25)	17.10 (3.73)	**18.25 (2.75)**	-1.92 (20)	.035	-0.81

$\bar{x}$ = mean

SD = standard deviation

df – degrees of freedom

* *One*-tailed t-test was conducted for the Mind in the Eyes test

Table 3: Correlations

Variable	SSRS Total Social Skills *r,p*	BRIEF Behavior Regulation *r,p*	BRIEF Metacognition *r,p*	Age *r,p*
Vineland-II Socialization	.80, p<.001	-.36, ns	-.22, ns	-.20, ns
Vineland-II Interpersonal Relationships	.75, p<.001	-.30, ns	-.14, ns	-.33, ns
Vineland-II Coping	.75, p <.001	-.22, ns	-.33, ns	.10, ns
Vineland-II Play and Leisure Time	.74, p <.001	-.45, p = .04	-.12 ns	-.28, ns
SSSRS Total Social Skills	-	-.39, ns	-.54, p < .05	.22, ns
Mind in the Eyes	-	-	-	.70, p < .01

SSRS Total Social Skills = Social Skills Rating Scale Total Social Skills

BRIEF = Behavior Regulation Inventory of Executive Functioning

Table 4: Multiple Stepwise Regressions table for hypothesis testing

Hypothesis 2a: Vineland – II Socialization Domain

		R^2	F	B	SE	$Beta$	t	p
Step 1:								
	Group			18.03	6.64	.52	2.72	.01*
		.27	7.38					
Step 2:								
	Group			20.50	7.27	.59	2.82	.01
	Mind in the Eyes			-.86	1.01	-.18	-.86	.40
		.30	4.01					

Note. $\Delta R^2 = .03$ *for Step 2*

Hypothesis 2b: SSRS Total Social Skills

		R^2	F	B	SE	$Beta$	t	p
Step 1:								
	Group			18.29	6.48	.547	2.82	.01*
	BRIEF Metacognition			-1.18	.30	-.66	-3.97	.001*
		.50	9.67					
Step 2:								
	Group			19.20	7.40	.49	2.60	.01*
	BRIEF Metacognition			-1.20	.31	-.67	-3.82	.001
	Mind in the Eyes			-.28	1.00	-.05	-.28	.78
		.51	6.16					

Note. $\Delta R^2 = .002$ *for Step 2*

SSRS Total Social Skills = Social Skills Rating Scale Total Social Skills

Table 5: Partial Correlations for mind in the eyes performance and dependent variables controlling for age and group

Variables	Mind in the Eyes	
	r, p	*Mean (SD)*
Vineland-II Socialization	-.29, ns	87.36 (17.71)
Vineland-II Interpersonal Relationships	**-.41, .07**	12.18 (3.43)
Vineland-II Coping	-.18, ns	13.64 (2.79)
Vineland-II Play and Leisure Time	-.30, ns	11.95 (3.65)
SSRS Total Social Skills	-.25, ns	89.59 (19.80)

SSRS Total Social Skills = Social Skills Rating Scale Total Social Skills

Figure 1: Development of theory of mind time line

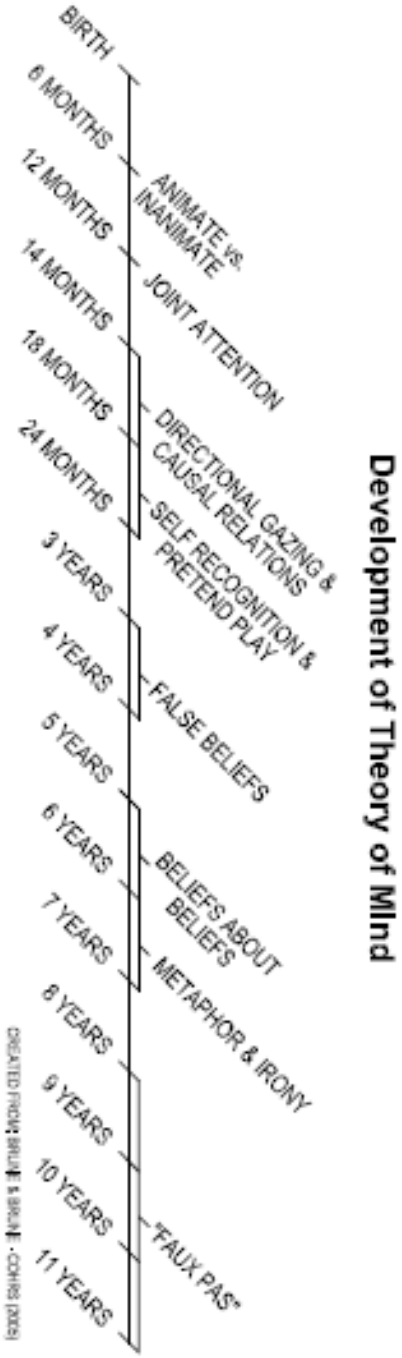


Figure 2: Revised version of the mind in the eyes test

Figure 3: Social Functioning and BRIEF scores

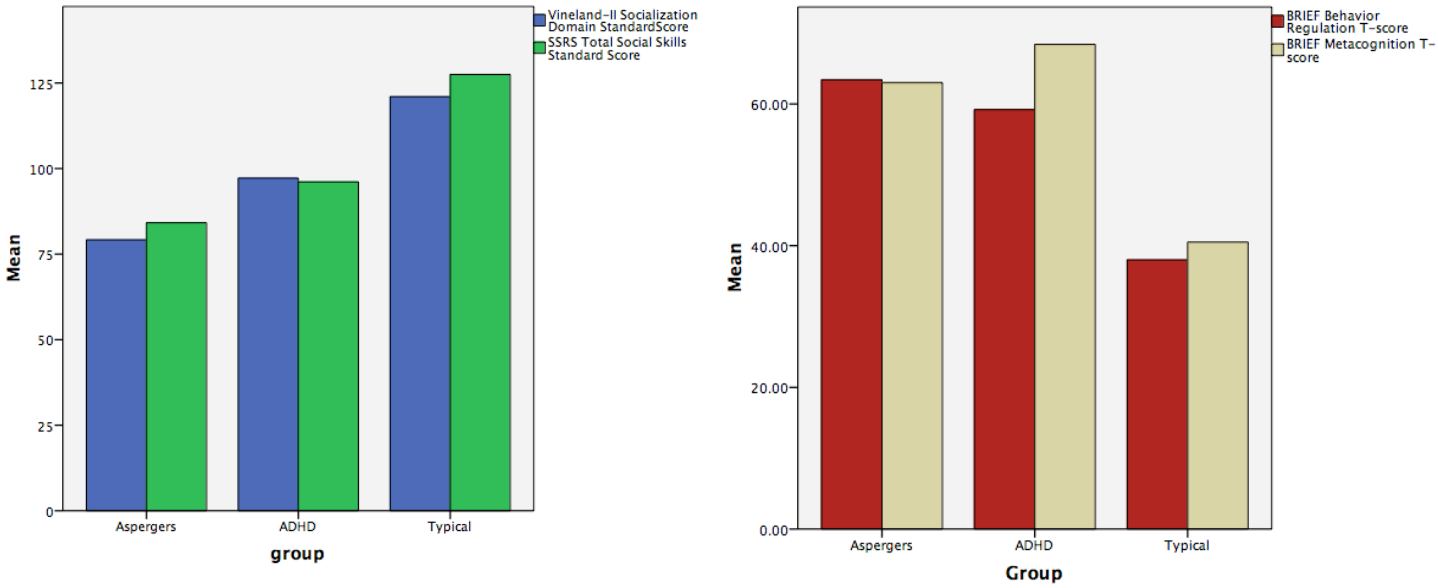


Figure 4: Mind in the Eyes Performance

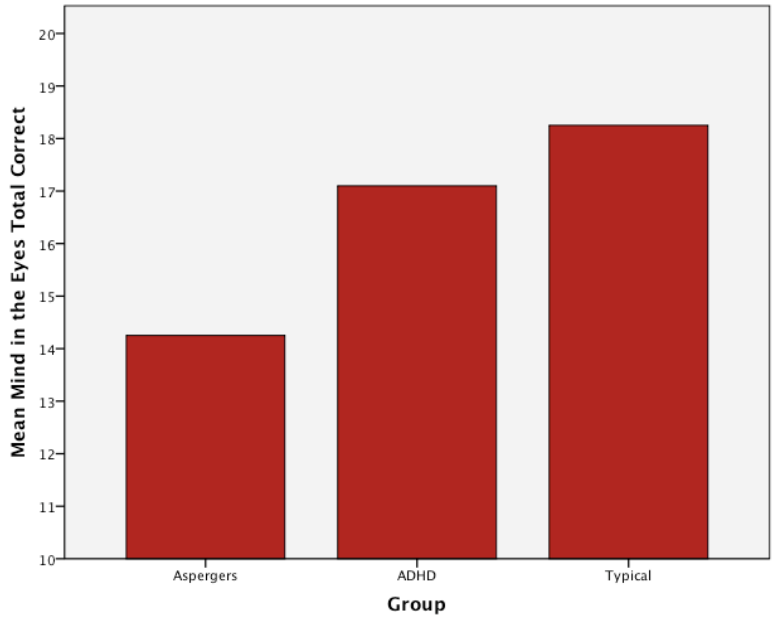
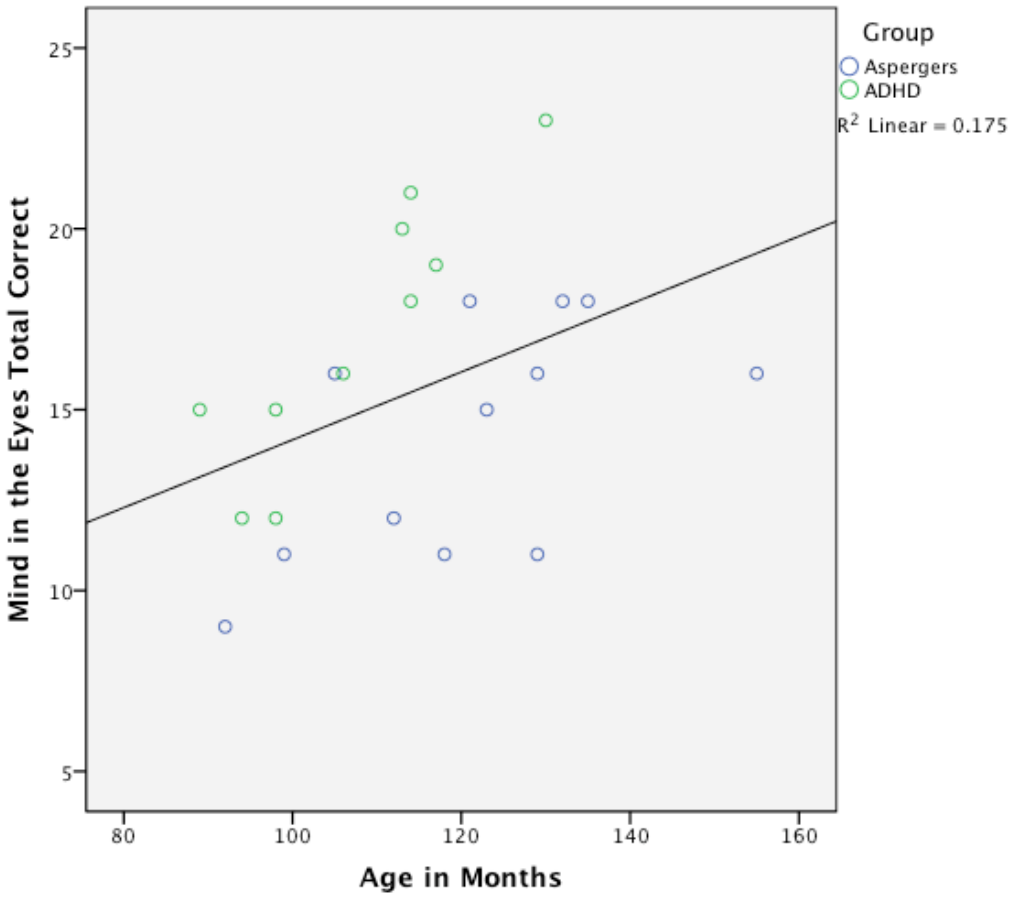


Figure 5: Correlation between Mind in the Eyes and Age



Appendix 1: Eligibility form

Eligibility Form for _____

Have you diagnosed this child with AS?	No	Yes
Have you diagnosed this child with ADHD?	No	Yes
Is this child between the ages of 7 and 12?	No	Yes
Did this child pass his or her last physical completed by a medical doctor?	No	Yes
Does this child have any health issues that would interfere with the study? (For example other psychological diagnoses or medical limitations?)	Yes	No
Has this child been diagnosed with any other psychological disorder?	Yes	No
Does this child have a significant visual impairment or hearing problem that would significantly impact his or her ability to understand and respond to questions?	Yes	No
Has this child been diagnosed with a significant impairment which would impact his or her ability to understand the questions we would as him or her?	Yes	No

Vita

Sarah Levin Allen, M.S.

I. EDUCATION

Ph.D.	**Drexel University,**
Anticipated	Philadelphia, Pennsylvania
2010	Major: Clinical Psychology; Concentration: Neuropsychology
	(Full accreditation by the American Psychological Association)
M.S.	**Drexel University,**
2008	Philadelphia, Pennsylvania
B.S.	**Drexel University**
2005	Philadelphia, PA
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II. AWARDS AND HONORS

2008 **Community Service Project Award,** *PPAGS*
2006 **Graduate Student Grant,** *Drexel University*

III. SELECTED PUBLICATIONS & PRESENTATIONS

Levin Allen S, O'Hara, E., LeGoff, D.B., Chute, D., Barakat, L.P. (2009) Mental State Attribution and Adaptive Social Functioning in Children with Asperger's Disorder. To be presented at the *National Academy of Neuropsychology Conference,* New Orleans, LA.

Mintz, M., LeGoff, D.B., Scornaienchi, J., Brown, M., **Levin Allen, S.,** Mintz, P. & Smith, C. (2009). The under-recognized epilepsy spectrum: The effects of levetiracetam on neuropsychological functioning in relation to subclinical spike production. *Journal of Child Neurology*.

LeGoff, D., Kraus, G.W., **Levin Allen**, S. (2009). "Lego Club:" A peer based and naturalistic group for enhancing social competence. In A. Drewes & C. Schaefer (Eds.), *School-based Play Therapy: Second Edition*.

Levin Allen, S., Riggs Romaine, C., & Hoffman, K. (2008). Mental Health in the Classroom: A Community Service, Teacher-Training Project. *The Pennsylvania Psychologist,* 68 (6), 22-23.

Barakat, L.P., **Levin Allen,** S., Nicolaou, D.C., & O'Hara, E. (2008). Sickle cell disease. In W. O'Donohue & L. Tolle (Eds.), *Behavioral Approaches to Chronic Disease in Adolescence*. In press.

IV. CLINICAL TRAINING/PROFESSIONAL EXPERIENCE:

2008-2009 **School Psychology Extern:** *Haddonfield Memorial School District*
2008-2009 **Psychological Intervention Trainee:** *The Center for Neurological and Neurodevelopmental Health*
7/07-7/08 **Neuropsychology Extern**: *St. Christopher's Hospital for Children*,
6/06-6/07 **Neuropsychology Extern**: *The Children's Hospital of Philadelphia*,
2/08-6/08 **Interventionist**: CAREE program, *Children's Hospital of Philadelphia*
7/07 **Interventionist**: *Dragonfly Forest Camp*
1/06-4/06 **Neuropsychology Specialist:** *Private Pediatric Neuropsychology Practice*
4/05-12/05 **Neuropsychology Specialist**: *Bancroft NeuroHealth*
9/03-4/04 **Neuro-Rehab Therapy Assistant:** *The Children's Hospital of Philadelphia*
9/02-4/03 **Rehab Tech:** *Drucker Brain Injury Center, Moss Rehabilitation*