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FACIAL EMOTION RECOGNITION AND SOCIAL FUNCTIONING IN CHILDREN  
WITH AND WITHOUT ATTENTION DEFICIT/HYPERACTIVITY DISORDER

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## ABSTRACT

**Objective:** ADHD is associated with negative outcomes across many areas of functioning, particularly in social skills and peer relations. There are many potential variables that may contribute to social skills deficits and negative peer relationships, including the ability to recognize facial emotions. The current project explores the links between this ability and social functioning in children with and without ADHD, including possible mediations of age and gender. **Methods:** 129 children categorized as ADHD and 63 controls completed a computer based facial emotion recognition task using standardized black and white photographs of adults displaying happy, sad, mad and scared faces. In addition, one parent and teacher of each participant completed a questionnaire regarding the child's social skills and quality of peer relationships. **Results:** Control participants displayed significantly faster reaction times to happy faces and sad faces, as well as greater accuracy in identifying these faces. In addition, there were significant correlations between age and reaction times to happy and sad faces, such that younger children displayed slower reaction times to these stimuli. No significant results were found for a main effect of gender upon measures of facial emotion recognition. Finally, it was found that participants' abilities to accurately recognize emotions were not significantly correlated with parents' and teachers' ratings of their social skills and peer relations. **Conclusion:** These findings suggest that differences exist in the ability of children with ADHD to react to and correctly identify facial emotions. Potential reasons for a lack of significant correlation to social skills and quality of friendships is discussed.

**TABLE OF CONTENTS**

Abstract.....	i
Table of Contents.....	ii
Acknowledgements.....	iii
INTRODUCTION.....	1
PURPOSE.....	19
METHODS.....	20
RESULTS.....	22
DISCUSSION.....	23
References	
Appendices	

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## Introduction

### *Attention-Deficit/Hyperactivity Disorder*

Attention-Deficit/Hyperactivity Disorder (ADHD) is a very prevalent disorder among children and adolescents (Rader, McCauley, & Callen, 2009). The symptoms of ADHD include hyperactivity, impulsivity, and inattention, which can affect an individual's functioning throughout his or her lifespan (Rader et al., 2009). Co-morbid disorders are common with ADHD and further compromise one's ability to function (Spencer, Biederman, & Mick, 2007). In addition, the prognosis for adults is bleak, as they often continue to have difficulty in multiple areas of functioning (Rader et al., 2009).

The *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., American Psychiatric Association, 1994) divides ADHD into three subtypes: Primarily Inattentive, Primarily Hyperactive/Impulsive, and Combined. In order to be diagnosed with the first subtype, a child must have six or more symptoms of inattention and less than six symptoms of hyperactivity and/or impulsivity. The second subtype requires the child to exhibit six or more symptoms of hyperactivity or impulsivity and less than six symptoms of inattention. Finally, a child who displays six or more symptoms of both inattention and hyperactivity/impulsivity would fall into the Combined subtype (*DSM-IV*). ADHD symptoms must appear for at least six months, start before the age of seven and cause issues in the child's functioning in at least two settings, or be inconsistent with the expected developmental level of the child.

The symptoms of inattention include: having issues with paying attention to details; difficulty maintaining attention during tasks, as well as organizing and completing them; appearing to not listen even in one on one conversation; seeming to avoid tasks that would require paying attention for an extended period; losing items regularly; becoming distracted

easily and forgetting things often (*DSM-IV*). The symptoms of hyperactivity include: fidgeting and talking often; getting up from a seat, running, or climbing often at the wrong time; having problems completing activities quietly; and having excessive energy often. Finally, the symptoms of impulsivity include: problems waiting one's turn; frequently interrupting conversations or activities; and stating answers out of turn.

A variety of approaches are used to make a diagnosis of ADHD. Clinical interviews are the most common (Brown, 2000). They are considered a reliable source when used with children who are at least ten years old for the purpose of determining the severity of their internalizing symptoms (Brown, 2000). Interviews with a child's parent and teacher are used to determine if impairment is present in at least two settings, (Mitsis, McKay, Schulz, Newcorn, & Halperin, 2000) although obtaining an appropriate level of agreement between both parties can be difficult (Antrop, Roeyers, Oosterlaan, & Van Oost, 2002). They can also provide information about the overall health of the child, as well as his or her course of development and school performance (Brown, 2000). Finally, the subjective methods described above are often paired with objective rating scales of behavior, as they provide greater reliability (Brown, 2000). Based on the methods described above, Brown (2000) estimates that between three and five percent of children have ADHD, and about fifty percent of children referred to clinics may have the disorder. However, out of all the children who meet the requirements of the disorder, about half lack a diagnosis or consistent medication regime, and the bulk of these children are stricken by poverty (Froehlich et al., 2007).

There are several theories regarding the etiology of ADHD. Some studies have suggested that children with ADHD may have a neurological problem because they have a lower amount of brain activity in areas that control attentional processes (Brown, 2000). Studies with families

and twins provide evidence of a genetic basis (Brown, 2000; Dunn and Kronenberger, 2003; Willcutt, Pennington, & DeFries, 2000b). In addition, mothers who smoke, have high levels of stress, or are exposed to lead while pregnant are more likely to have a child with ADHD, especially if the fetus is exposed to more than one of these risk factors (Froehlich et al., 2009; Motlagh et al., 2011; Rodriguez & Bohlin, 2005). In addition, infants with acute sleep issues show higher rates of ADHD once they reach a diagnosable age (Thunstrom, 2002). Recent research has found that children who are exposed to air pollution from cars (Siddique, Banarjee, Ray, & Lahiri, 2011) or to general anesthesia many times before they turn two years old (Sprung et al., 2012) are more likely to develop ADHD. There are also certain factors which may affect the severity of a child's ADHD or related symptoms. Girls with ADHD are more likely to become delinquent during childhood given a history of familial violence (Becker and McCloskey, 2002). In addition, the parents of children with ADHD tend to use more hostile, controlling, and negative parenting methods (Cunningham and Boyle, 2002; Cussen, Sciberras, Ukoumunne, & Efron, 2012).

In addition to the difficulties associated with ADHD, many children are also hindered by co-morbid disorders or issues. Some studies have shown that up to fifty percent of children with ADHD will develop Conduct Disorder, Oppositional Defiant Disorder, or a mood disorder, and anxiety disorders are also common (Brown, 2000; Dilsaver, Henderson-Fuller, & Akiskal, 2003). Fifteen to twenty percent of children with ADHD will have issues with substance abuse (Barkley, 2004). Issues with depression and suicide are much higher in children with ADHD than those without (Chronis-Tuscano et al., 2010; Daviss, 2008). Recent research has also found that epilepsy is more common in children with ADHD than those without, and tends to be more severe (Davis et al., 2010). Children with ADHD are more likely to have sleeping problems

(Owens, Maxim, Nobile, McGuinn, & Msall, 2000). They are also more prone to accidental injuries, due to their proclivity towards hyperactivity and impulsivity (Shilon, Pollack, Aran, Shaked, & Gross-Tsur, 2012).

Educational difficulties are common among those with ADHD. Only about sixty four percent will complete high school (Barkley, 2004). Children with ADHD are more likely to repeat a grade and they tend to achieve lower test scores and grades in reading and math compared to their peers. They also feel less competent in themselves (Ek, Westerlund, Holmberg, & Fernell, 2011; Hanc & Brzezinska, 2009; Loe & Feldman, 2007; McConaughy & Volpe, 2011) and show lower academic achievement (Biederman et al., 2004). Many of these educational issues can be linked to executive functioning deficits, which are common in those with ADHD (Miller, Nevado-Montenegro, & Hinshaw, 2012). Finally, they are more likely to have reading disabilities (Willcutt & Pennington, 2000a; Willcutt, Pennington, & DeFries, 2000c).

Sadly, the prognosis for children with ADHD is not always positive. Only twenty to thirty percent of children will cease to display symptoms as adolescents, and four to five percent of children will still have the disorder as adults (Barkley, 2004; Sibley et al., 2012). Although the percentage is small, children whose continue to display symptoms into adulthood must learn to handle these issues with the added difficulties of increased expectations and responsibilities of this new developmental phase (Adler and Chua, 2002; Biederman, Petty, Evans, Small, & Faraone, 2010; Halperin, Trampush, Miller, Marks, & Newcorn, 2008). Problems in education continue, while new challenges, such as learning how to drive (Barkley, 2004), maintaining steady employment (de Graaf et al., 2008) and handling close relationships begin as a child ages (Adler & Chua, 2002; Barkley, 2002).



Co-morbid issues are also a continuous presence. It is estimated that seventy percent of those with adult ADHD have at least one co-morbid disorder (Garcia et al., 2012). One study found that forty percent of adults met the DSM diagnosis for Social Anxiety Disorder (Edel et al., 2010). Another found that twenty-six percent of primarily hyperactive adults also had Major Depressive Disorder, twenty-one percent had Antisocial Personality Disorder, eighteen percent had Passive-Aggressive Personality Disorder, fourteen percent had Borderline Personality Disorder and twelve percent had Histrionic Personality Disorder (Fischer, Barkley, Smallish, & Fletcher, 2002). The likelihood of having a co-morbid personality disorder in adulthood is directly proportional to the severity of ADHD symptoms in childhood (Matthies et al., 2011). Substance abuse problems usually begin sometime during adolescence and often persist into adulthood (Smith, Molina, & Pelham, 2002). In one study, a third of participants with alcohol-dependence had ADHD, while over half of those with substance-dependence had ADHD (Ohlmeier et al., 2008). Adults with co-morbid substance abuse issues are less likely to successfully complete treatment for their issues and usually function at a lower level compared to those without (Smith et al., 2002).

### *Developmental Differences and ADHD*

Another issue to contend with in regards to ADHD is that certain developmental differences, specifically pertaining to age and gender, have become prevalent within the research literature. Younger children (three to five years of age) in a clinic-derived sample were shown to have all three symptom subtypes to some degree, while adolescents were more likely to display more inattentive symptoms (Nolan et al., 1999). Also, younger children in this sample who exhibited hyperactivity and impulsivity were more likely to present with co-morbid ODD, CD, or anxiety disorders than those who only had issues with inattention.

Generally, the intensity of symptoms subsides as a child ages, particularly hyperactivity, (Adler & Chua, 2002; Brocki, Tillman, & Bohlin, 2010) while inattention remains steady (Nolan, Volpe, Gadow, & Sprafkin, 1999). Older children have been shown to perform better than their younger counterparts on Continuous Performance Tasks (CPT) (Brocki et al., 2010). Gunther, Jolles, Herpertz-Dahlmann, & Konrad (2009) found similar results using a sustained attention task and the Go-No-Go task. Those with ADHD performed worse than controls, but these differences became less apparent with time.

However, older children with ADHD still have many issues to contend with. They tend to display worse social skills (Booster et al., 2012), act more aggressively, and have more problems with their peers than younger children (Schmidt & Petermann, 2009). They have more problems completing their homework, (Booster et al., 2012) getting along with their teachers, and maintaining their motivation to do well in school (Schmidt & Petermann, 2009). They are more likely to develop friendships with peers who have similar issues to their own, which increases the likelihood of delinquency, substance abuse and other negative behaviors (Schmidt & Petermann, 2009).

Differences are also apparent among executive functioning skills based on a child's age. Among children aged six to thirteen years, Brocki & Bohlin (2006) found that poor inhibition was related to symptoms of ADHD, while the inability to acquire and use more complicated executive functions was related to ADHD symptoms for older children. In addition, Sowerby, Seal, & Tripp (2011) found that among children with the Combined Subtype of ADHD, those younger than eight has issues in their verbal working memory, while older children did not. Finally, Tillman, Eninger, Forssman, & Bohlin (2011) found that verbal short-term working memory was predictive of symptoms of inattention for older children.

Although symptoms of hyperactivity and impulsivity tend to decline with age, Langberg et al. (2008) found that the move to middle school may be an exception to this typical trajectory. Using seven to nine year old children with ADHD and matched controls, they found that hyperactivity, impulsivity and inattention all decreased once the transition was over. However, parents rated their children with ADHD as having an uptick in all three types of symptoms during the initial period of transition. This was also the case in teachers' ratings of hyperactivity and inattention. This provides evidence that although children with ADHD may experience a decline in symptoms upon entering adolescence, periods of increased responsibility, demands, and stress may trigger temporary increases in the severity of their disorder.

Both genders tend to have comparable clinical profiles based on standard diagnostic criteria, (Biederman et al., 2002) and analogous rates of neutral behaviors, such as inattention (Abikoff et al., 2002). In addition, the average age of onset is similar between both genders, but the prevalence of ADHD varies between boys and girls (Barkley, 1988). About five to seven percent of boys display the disorder, while only two to four percent of girls have ADHD (Barkley, Fischer, Edelbrock, & Smallish, 1990). These numbers vary slightly based on

sampling techniques. Among more representative samples from population based studies, the ratio of males to females with ADHD is about 3:1, but increases to anywhere between 5:1 and 9:1 among clinical samples (Bruchmuller, Margraf, & Schneider, 2012; Hasson & Fine, 2012; Jackson & King, 2004). In addition, a large portion of research regarding ADHD includes many more male participants than females (Hasson & Fine, 2012).

ADHD tends to be diagnosed more often in boys than girls (Brown, 2000) and boys are more likely to receive pharmacologic treatment, although girls tend to receive higher doses of psychostimulants than boys (Sarawate & Hankin, 2003). Earlier corresponding evidence suggested that boys displayed more hyperactive and aggressive behaviors than girls based on parent and teacher ratings (Hasson & Fine, 2012; Jackson & King, 2004). Thus, it was put forth that because girls were more likely to display symptoms of the Inattentive Subtype, their symptoms would not become apparent until they entered school, and therefore, they were less likely to be diagnosed in early childhood like their male counterparts (Bruchmuller, 2012). Various studies provided supporting evidence for this claim. Among a study using children ages seven to ten years old, boys with ADHD tended to have more externalizing and rule breaking behaviors compared to girls with ADHD (Abikoff et al., 2002). Similarly, Biederman et al. (2002) found that girls in their sample displayed more internalizing and learning problems, while boys showed more disruptive disorders, and were more likely to fit the diagnosis for the Combined Subtype.

These results were replicated by Levy, Hay, Bennett, & McStephen, (2005) who found that among a large sample of Australian twins with ADHD, boys were more likely to have ODD or CD. Girls were more likely to display Separation Anxiety Disorder, particularly if they were

categorized in the Predominantly-Inattentive subtype. Girls included in the Combined Subtype were more likely to co-morbid Generalized Anxiety Disorder.

A study using Puerto Rican children ranging from four to seventeen years of age found similar results (Bauermeister et al., 2007). ADHD was 2.3 times more common among the boys in the sample (Bauermeister et al., 2007). Differences between genders appeared when the sample was broken down by ADHD subtype. Among the combined subtype, boys were more likely to have a co-morbid mood disorder (Bauermeister et al., 2007). Among those with the inattentive subtype, girls were more likely to have an anxiety disorder (Bauermeister et al., 2007).

However, newer evidence suggests that differences in the expression of ADHD may not be directly affecting the differing rates of diagnoses between the genders. In a meta-analytic study based on peer-reviewed articles that utilized CPTs, Hasson and Fine (2012) found that boys do tend to be more hyperactive than girls. However, there was not a significant difference in the severity of inattention between boys and girls. Instead, the tendency of diagnosticians to view boys as more archetypal ADHD patients, and to thus gloss over some of the standards of the DSM-IV-TR criteria, may be the source of the gender gap, and perhaps even contribute to overdiagnosis of the disorder (Bruchmuller, 2012). An overview of all evidence suggests that there are slight differences in how boys and girls experience their ADHD symptoms, but there is a tendency to only give ADHD diagnoses to girls who have severe symptomology (Hasson & Fine, 2012).

Teachers also have different views of boys and girls with ADHD. Scitutto, Nolfi, & Bluhm (2004) found that teachers were more likely to refer boys than girls, irrespective of the type of symptoms displayed. In addition, they were most likely to refer children with

hyperactivity or impulsivity rather than inattentive symptoms, regardless of gender. These findings are quite different from the results of a study by Coles, Slavec, Bernstein & Baroni (2012). In their study, teachers thought girls with ADHD were having more issues managing their symptoms and needed intervention more so than their male students with ADHD. Those displaying more inattentive symptoms were rated as being the least affected by their symptoms, regardless of gender. Finally, girls who exhibited hyperactive and impulsive symptoms were considered the most impaired.

A study by Jackson and King (2004) focused on how teachers perceive children exhibiting ADHD and ODD behavior compared to control children who are not. The male and female models used the same script and the resulting videotapes were shown to teachers, who then rated the children's levels of various symptoms. When the children displayed more oppositional behavior, the teachers were more likely to rate them as hyperactive and inattentive. When the children displayed ADHD specific behaviors, they were rated as showing more oppositional behavior. This relationship varied by gender. When the male actor portrayed ADHD, the teachers' ratings of hyperactivity and inattention were twice as high compared to the ratings he received after only displaying oppositional behavior. However, the girl received lower ratings of oppositional defiance when she portrayed ADHD compared to when she just portrayed oppositional behavior.

In a longitudinal study, Berlin, Bohlin, & Rydell (2003) assessed inhibition in children at five years of age and continued until they were eight and a half years old. Inhibition was strongly correlated to ADHD symptoms at home and school for boys, but only at school for girls. They found that for boys only, inhibition at the preschool age was a significant predictor of executive functioning, which predicted ADHD symptoms.

### *Social Competence and ADHD*

Although it is clear that children and adults with ADHD can encounter a multitude of issues that may inhibit their functioning, social issues are of particular concern. Social dysfunction is one of the strongest predictors of prognosis for a child with ADHD (Graziano, Geffken, & McNamara, 2011). However, due to their difficulties in regulating their attention, emotions, and behavior, (Graziano et al., 2011) children with ADHD tend to have lower social competence (McConaughy & Volpe, 2011). Social competence refers to an individual's ability to comprehend a social situation, identify the appropriate response, and then follow through with that response (Semrud-Clikeman, 2010). A child's level of social competence is determined by what is considered acceptable for their developmental stage. Young children are supposed to develop self-control and respond to requests from others in an appropriate way. Those in middle childhood should show that they understand what the appropriate moral and social behaviors are for their society with less assistance from adults. Finally, adolescents should show even more independence and mastery in making social decisions (Matsen & Coatsworth, 1998).

In a longitudinal study that began with participants in middle childhood, four aspects of social competence (social skills, peer rejection, aggression and positive illusory biases) were assessed four times over a six year period. Every group – ADHD, ADHD treatment, and comparison – experienced issues with these aspects during the first assessment, even after controlling for age, and results were similar among boys and girls (Murray-Close et al., 2010). It was concluded that all children may experience peer problems, but those with ADHD are afflicted by more issues compared to their unaffected peers.

Among children with ADHD, several factors are implicated in the level of social competence displayed. These include the amount of externalizing and abnormal behaviors

present, (Graziano et al., 2011) as well as the lack of social skills, issues with controlling emotions or processing social information, and stigma from peers (Jack, Mikami, & Calhoun, 2011). In addition, the style of parenting used by those raising children with ADHD can affect levels of aggression and social competence. Positive parenting was associated with better social skills and less aggression, while negative parenting had the opposite result (Kaiser, McBurnett, & Pfiffner, 2010).

Some recent research indicates that social problems occur in children with ADHD not because they do not have adequate knowledge of how to socialize, but because they do not know how to utilize this knowledge in an appropriate and effective manner when interacting with others (Huang-Pollock, Mikami, Pfiffner, & McBurnett, 2009; Kofler et al., 2011). This is supported by the results of social skills training studies, in which children with ADHD were able to demonstrate appropriate social behaviors when prompted (Kofler et al., 2011). In addition, other studies have shown that children with ADHD who were not receiving social skills training showed improved social interactions while on a medication regime (Kofler et al., 2011). It is possible that the underlying reason for these deficits is an issue with working memory in children with ADHD. Children with ADHD have shown difficulties with dividing their attention between items in their working memory and social cues in the environment (Kofler et al., 2011). The researchers of this study believe that such children may act quickly, without thinking through their actions first, because they are concerned that they may forget what is going on before they have a chance to react (Kofler et al., 2011).

Regardless of the cause of social competence issues, they carry numerous consequences. Children with ADHD pick up on fewer social cues compared to their peers, (Andrade et al., 2011; Kaiser et al., 2010) which has been linked to verbal and physical attacks in school



(Kowalski & Fedina, 2011). Due to their difficulties with attention, they miss out on chances to gain social skills by observing the actions of their peers (Kawabata, Tseng & Gau, 2012). They also tend to generate more inappropriate responses in social situations than those without ADHD (Andrade et al., 2011) and their teachers are more likely to find them socially incompetent (Lee, Falk, & Aguirre, 2012). Children with a co-morbid disorder tend to have more social problems, especially as they age (Booster, DuPaul, Eiraldi, & Power, 2012; Graziano et al., 2011). This is especially true for those who have ODD, CD or anxiety-related disorders (Lee et al., 2012).

They have also been shown to express less empathy and pro-social behavior than their unaffected peers (Andrade et al., 2011; Braaten & Rosen, 2000; Graziano et al., 2011). This is a cause for concern, as the presence of pro-social behavior is a sign that a child has positive social abilities (Andrade et al., 2011). These issues are made more complex by the issue of the positive illusory bias. Compared to impartial observers (Kawabata et al., 2012; Lee et al., 2012; Murray-Close et al., 2010) and the ratings of teachers and peers, (Kofler et al., 2011) children with ADHD tend to believe they are more socially skilled than they really are (Kawabata et al., 2012; Lee et al., 2012; Murray-Close et al., 2010).

Thus, it is not too surprising that children with ADHD have issues with peer relationships. It is estimated that at least half of children with ADHD are exposed to rejection from peers (Huang-Pollock et al., 2009). However, the concern is not just that children are often rejected by their peers, (Andrade et al., 2011; Graziano et al., 2011; Jack et al., 2011; Kaiser et al., 2010; Redmond, 2011) but that this rejection occurs quickly after they begin an interaction (Glass, Flory, & Hankin, 2010; Graziano et al., 2011; Jack et al., 2011; Kaiser et al., 2010). Children without ADHD have rated their afflicted peers as less popular and capable after only one minute, (Redmond, 2011) while others have noted that children with ADHD are criticized

and rejected by their peers after thirty minutes (Kofler et al., 2011). In addition, once peer rejection has occurred, it is very difficult to change (Murray-Close et al., 2010).

Children with ADHD have more problems making and keeping friends (Cardoos & Hinshaw, 2011; Kawabata et al., 2012; Lee et al., 2012) and have fewer, more unstable and less satisfying peer relationships (Bernardi et al., 2012; Glass et al., 2010; Graziano et al., 2011; Hantson et al., 2011; Murray-Close et al., 2010; Normand et al., 2011; Redmond, 2011). Children with ADHD tend to show less tact when compromising, (Normand et al., 2011) and are more impulsive, aggressive, demanding, and unyielding with their friends (Glass et al., 2010; Kofler et al., 2011; Kowalski & Fedina, 2011) because they have difficulty handling their emotions appropriately (Graziano et al., 2011). This can be detrimental to a child's development, as it increases the likelihood of maladaptive social adjustment (Kawabata et al., 2012). For example, adolescents with ADHD who had supportive relationships were more involved in school and had higher self-esteem. Those with unsupportive relationships were more likely to be involved in negative behaviors, such as substance use (Glass et al., 2010).

One particularly detrimental outcome of low social competence is peer victimization. Two studies have found that peer victimization occurs more often in girls with ADHD than those without (Cardoos & Hinshaw, 2011; Sciberras, Ohan, & Anderson, 2012). Furthermore, this type of victimization was linked to multiple negative outcomes, including more externalizing and internalizing problems, as well as decreases in self-esteem and one's perception of social competence (Cardoos & Hinshaw, 2011). There were also direct outcomes related to school, such as avoiding attending school, loneliness in school, and lowered performance (Cardoos & Hinshaw, 2011). A related study found that children with ADHD are more likely to become

victims of bullying compared to their peers. This was correlated with higher rates of depression, anxiety and suicidal ideation, and lower self-esteem and grades (Kowalski & Fedina, 2011).

Perhaps the most alarming aspect of social functioning issues in children with ADHD is that these problems tend to persist often into adolescence and adulthood, (Bernardi et al., 2012; Brod, Schmitt, Goodwin, Hodgkins, & Niebler, 2011; Kofler, 2011; Petersen & Grahe, 2012) even if ADHD symptoms decrease over time (Lee et al., 2012). In order to improve children's prognoses, social skills training programs have been developed, but these programs often have mixed results (Hantson et al., 2011). Some only achieve improvement in certain areas of social functioning, or for particular subsets of the sample, such as those with a comorbid disorder. The most effective programs appear to be those that focus on understanding emotions, as well as understanding one's own and others' perspectives (Hantson et al., 2011).

### *Emotion Recognition and ADHD*

Social competence has been suggested as a source of concern for those with ADHD, and emotion recognition is a core feature of this construct that has received increasing attention. Singh et al. (1998) had fifty children and adolescents diagnosed with ADHD under the DSM-III-R identify the six basic emotions of fear, anger, sadness, happiness, disgust or surprise. The participants listened to a paragraph that described an event. Then, they pointed to the face that pertained to the emotion that had been described. Across all the emotions used, the participants chose the correct response 74% of the time. Happiness was identified correctly most often, while fear was correctly identified least often. Compared to those without ADHD, these results suggested that children with ADHD are capable of recognizing facial expressions, but may struggle to recognize facial emotions because of their difficulties with attention (Singh, et al., 1998; Sinzig, Morsch, & Lehmkuhl, 2008).

A similar method was used in a study with thirty children categorized as Predominantly Hyperactive/Impulsive and thirty matched controls (Pelc, Kornreich, Foisy, & Dan, 2006). The seven to twelve year old children were asked to identify whether the sixteen faces shown to them were happy, sad, angry, or disgusted. The ADHD group had more difficulty classifying the pictures than the control group, especially in regards to the angry and sad faces. An additional self-report scale indicated that ADHD were not aware of their classification mistakes compared to the control group. In addition, children in the ADHD group with greater interpersonal problems were more likely to have issues in the recognition task, particularly for angry faces. Similar results were found in a study using Israeli boys who were considered at-risk for ADHD and matched controls (Kats-Gold, Besser, & Priel, 2007). The boys were asked to identify whether photographs of men and women were happy, sad, mad or scared. Again, the boys in the

potentially ADHD group appeared to have diminished emotion recognition skills compared to their matched controls. In addition, the researchers found that the at-risk group's difficulties with recognizing emotions were related to their social functioning and behavioral issues compared to the control group.

These results were also replicated using three different stimulus presentations, using video clips from a cartoon series and a sitcom (Boakes, Chapman, Houghton, & West, 2008). Twenty four boys with ADHD and twenty four matched controls identified faces that represented the six core emotions as described above. In the first style of the stimulus, twelve cards were drawn from the cartoon series, and twelve from the sitcom, with two examples of each emotion per set. In the second style, three versions of the stimulus scenes were created. The first consisted of still frames of facial expressions taken from the clips. The second version used quick excerpts from the original clips. The final version utilized the original ten second clips, which provided context to the emotional expressions, but sound was not included. The ADHD group showed poor performance in identifying fear and disgust across all the variations of the stimuli.

Da Fonseca, Segquier, Santos, Poinso, & Deruelle (2009) found similar results when they added contextual clues to a facial recognition task. Twenty-seven children and adolescents with ADHD were compared to a matched control group. The ADHD group performed worse on the traditional and supplemented version of the task. In an effort to pinpoint the specific impairment that causes emotion misrecognition among those with ADHD, Yuill & Lyon (2007) used a two-part study design. In the first part of the study, nineteen boys with ADHD and nineteen matched controls matched pictures of facial emotions to situations, and then completed a non-emotion based control task in which they identified a physical aspect of a face. The ADHD children had

poorer performance on both tasks compared to the control group, and stated that they had more difficulty with the emotion task than the control task. During the second part of the study, another set of boys with ADHD and matched controls completed the same tasks from Part 1. However, the procedure was altered so that the ADHD group would be less likely to hurt their scores by responding impulsively. This time, the ADHD group performed similarly to the control group on the control task, but still had lower scores on the facial emotion recognition task. The researchers believe that these results reflect the fact that children with ADHD have difficulty understanding how emotions are related to situations.

Williams et al. (2008) sought to determine if stimulant medication could improve emotion recognition among those with ADHD, and if there was a neural source connected to this issue. In the first stage, fifty-one unmedicated adolescents with ADHD and matched controls completed an emotion recognition task while their brain activity was recorded. In the post-treatment phase, participants repeated this process after receiving methylphenidate treatment for four weeks. The ADHD group had more impairment in identifying expressions and abnormal neural activity during the pre-treatment phase. The addition of a stimulant regime provided some improvement to their emotion recognition performance, and resulted in a more typical sequence of brain activity.

Finally, a study by Rapport, Friedman, Tzelepis, & Van Voorhis (2002) suggests that issues with emotion recognition may continue into adulthood. Twenty eight adults and matched controls completed a facial emotion recognition task in which black and white photographs of the six basic emotions were shown on a computer screen, and participants identified what emotion was being projected. Adults with ADHD performed much worse on the recognition task than their control counterparts.

## Purpose

Given the prevalence and possible outcomes of social functioning issues among children with ADHD, and the influences of age and gender, it is imperative that these issues be studied further. Therefore, this analysis will attempt to answer the following questions:

*Guiding Question 1:* Do children with ADHD have more difficulty recognizing core emotions than those without?

*Guiding Question 2:* Do differences in age (developmental level) and gender influence a child's ability to recognize core emotions?

*Guiding Question 3:* Does this difficulty lead to problems with social functioning and peer relations?

The hypotheses based on these questions are as follows:

*Hypothesis 1:* It is predicted that there will be a main effect of ADHD status on Emotion Recognition Task Scores.

*Hypothesis 2:* The relationship described above will be moderated by age and gender. Specifically, males and younger participants (8 years old) will have less success than female and older participants (12 years old).

*Hypothesis 3:* Participants who have greater difficulty in recognizing emotions will also have a greater number and variety of social functioning and peer relation issues.

## Methods

### *Participants*

Participant characteristics can be found in Table 1. Data was collected from 192 participants ages 8-12. 129 were placed into the ADHD group and 63 in the control group based on parent and teacher questionnaires. There were 110 boys and 82 girls. 146 (76%) of participants identified as Caucasian, 18 (9.4%) identified as African American, 5 (2.6%) identified as Hispanic, 2 (1%) identified as African American Hispanic, 3 (1.6%) identified as Other Hispanic, 1 (0.5%) identified as Asian, 14 identified as mixed race, and 3 did not provide ethnic/racial information. Prior to participation in the study, parents provided informed consent and children provided written assent. All procedures were approved by a university Institutional Review Board. Children and their parents were recruited from Centre County in Pennsylvania. Exclusion criteria included an FSIQ of below 80 for any participants, or above 115 for control participants only, and/or the presence of a pervasive developmental disorder, thought disorder, or a speech/language disorder. Children using a short or long term stimulant medication were required to discontinue the use of the medication for at least 24 or 48 hours, respectively.

### *Emotion Recognition Task*

Participants were asked to complete a computer based task in which they had to identify whether the person pictured in a black and white photograph on the screen was displaying a happy, sad, mad, or scared face. A response box was used with labels to show participants the corresponding button that should be used for each emotion. A new picture would appear as soon as a participant selected a response. If a child did not choose a response, the picture would change automatically after 2 seconds.



*Social Skills*

Participants' social skills were assessed using the standard scores of the Parents Social Skills Rating Scale (PSSRS).

*Peer Relations*

Participants' quality of friendships was assessed using the standard scores of the Teacher Peer Relations Scale (TPRS).

## Results

### *Hypothesis 1*

Performance on measures of facial emotion recognition for children with and without ADHD were submitted to a one-way Analysis of Variance (ANOVA). Results can be found in Table 2. There was a significant effect of ADHD status on select measures, such that control participants displayed faster reaction times to happy faces ( $F(1,190) = 6.808, p = 0.010, \eta_p^2 = 0.035$ ) and sad faces ( $F(1,190) = 4.304, p = 0.039, \eta_p^2 = 0.022$ ), and greater accuracy in identifying happy faces ( $F(1,190) = 3.916, p = 0.049, \eta_p^2 = 0.020$ ) and sad faces ( $F(1,190) = 5.219, p = 0.023, \eta_p^2 = 0.027$ ). No other significant results were found for the remaining measures of facial emotion recognition.

### *Hypothesis 2*

A one-way ANOVA was used to measure the effects of gender upon performance on the Emotion Recognition Task. Results can be found in Table 3. No significant results were found. In regards to the effects of age, there were significant correlations between age and reaction times to happy faces ( $r = -0.19, p = 0.008$ ) and sad faces ( $r = -0.18, p = 0.009$ ), such that younger children displayed slower reaction times to these stimuli. Results can be found in Table 4. A linear regression analysis was used to test for a possible interaction between ADHD status and age upon performance on the Emotion Recognition task. Results can be found in Table 5. No significant interactions were found for any measures of facial emotion recognition.

### *Hypothesis 3*

It was found that participants' abilities to react to and accurately recognize emotions were not significantly correlated with parents' and teachers' ratings of their social skills. These results can be found in Table 4.

## Discussion

### *Summary*

This project sought to determine if a link exists between facial emotion recognition and the quality of social functioning and peer relations in children with and without ADHD, given that the present research literature contains conflicting results about the nature of this relationship. In addition, the potential effects of age and gender on this relationship were explored in order to provide a more complete picture of nuances within participants' social functioning. In order to measure participants' ability to recognize facial emotions, reaction times to and accuracy in identifying happy, sad, angry, and scared faces from the Emotion Recognition Task were analyzed in relation to the Parent Social Skills Rating Scale and the Teacher Peer Relations Scale. Participants were recruited from Centre County and Harrisburg and screened using DSM-IV-TR criteria.

The results from 129 participants ages 8 to 12 who completed the Emotion Recognition Task and whose parents and teachers completed relevant measures showed the following. First, control participants had significantly faster reaction times to and greater accuracy in identifying happy and sad faces. There were no significant results of ADHD status upon the reaction times to or accuracy in identifying scared or angry faces. In addition, younger children displayed slower reaction times to happy and sad faces, but not to angry or scared faces. There were no additional significant results relating to age. Also, gender did not prove to have a significant effect on the eight measures of facial emotion recognition used in this study. Finally, no significant results were found regarding a connection between facial emotion recognition and social functioning or peer relations in the participants of this study, based on reports from their parents and teachers.

## *Implications*

### *Hypothesis 1*

As expected, participants categorized as controls performed better on all Emotion Recognition Task measures, although results were only significant for reaction times to and accuracy in identifying happy and sad faces. However, previous studies have found that children with ADHD tend to have more issues identifying facial sadness, anger, and fear, of which only the results regarding sadness were replicated by this study. The lack of significant effects on measures relating to angry or scared faces, and the abundance of previous data displaying contradictory results, may indicate that the particular sample used in this study was significantly different at outset compared to those that were recruited for previous studies. However, the possibility remains that children do not have issues in comprehending these particular emotions, regardless of whether they experience symptoms of ADHD or not. It is vital that future research seek out a consensus regarding what differences, if any, exist between children with and without ADHD in regards to their facial emotion recognition abilities.

The significant effect of ADHD status on measures relating to happy and sad faces indicates that those with ADHD symptoms may have a deficit in identifying these particular emotions. This is in direct contrast to the results of a study by Singh et al. (1998) in which happy faces were correctly identified most often. Given the variability of results within the currently available research literature, it would be very beneficial if future research in this area were to focus on the particular factors that are contributing to potential deficits in certain emotions and the larger role they may play in the social competencies of children with ADHD. This would include using larger and more heterogeneous samples in regards to demographic factors to parse out what the true relationship is between social functioning and each type of facial emotion. In

addition, this would inform potential interventions that may benefit children with ADHD who have limited and/or negative social skills or peer relationships.

### *Hypothesis 2*

The most recent research regarding gender differences in children with ADHD indicates that boys tend to be more hyperactive than girls, so it was predicted that female participants would display better performance on measures of facial emotion recognition. However, the results of a one-way ANOVA of gender did not reveal any significant results. Given that boys and girls with ADHD tend to have very similar clinical profiles and symptom severity, (other than the slight variability in hyperactivity) it may be that gender does not factor into differences in facial emotion recognition for children with and without ADHD. Future research should seek to confirm or disprove this assumption. If true, increased awareness of gender differences could inform interventions for children who have difficulty with facial emotion recognition.

In addition, the analysis of a potential interaction between age and ADHD status on facial emotion recognition measures did not yield significant results. While ADHD status alone did produce some significant results as described above, the addition of age did not have a significant impact on the participants' performances on facial emotion recognition measures. Past research on facial emotion recognition does not provide explicit information on interactions between these particular variables. Therefore, future research should explore these relationships further and test the reliability of this project's results.

Finally, a one-way ANOVA revealed that younger children had significantly slower reaction times to happy and sad faces. Previous research has shown that younger children tend to have more severe issues with hyperactivity and impulsivity, and that the severity of these symptoms generally lessen over time. Based on previous research, it may be that younger

children in this sample were suffering from more intense ADHD symptoms, and therefore displayed poorer performance on certain measures. However, future research should seek to determine if a majority of younger children have problems with happy and sad faces more so than other emotions, and possible causes for issues with these two particular emotions.

### *Hypothesis 3*

It was predicted that children who displayed poorer performance on measures of facial emotion recognition would display poorer levels of social functioning and lower quality peer relations as measured by parents' responses to the Parent Social Skills Rating Scale and teachers' responses to the Teacher Peer Relations Scale. However, there were no significant correlations found between these variables. Therefore, these results do not replicate the findings of Kats-Gold, Besser, & Priel, (2007). Upon comparing the results between a control group and a group considered at risk of developing ADHD, those in the at risk group had lower facial emotion recognition skills, and these issues were related to social functioning and behavioral issues. However, the sample consisted entirely of Israeli boys, so the lack of replication may be a result of divergent demographics between the two samples. Future research should definitely explore this relationship further to gain a deeper understanding what type of relationship, if any, exists between facial emotion recognition and the social competence of children with ADHD.

### *Limitations and Considerations*

There are several factors that must be taken into consideration when attempting to draw conclusions from this study. First, the generalizability of the results is limited by the sample size and lack of diversity among the participants, given that the areas of recruitment have limited racial diversity. Also, unlike past studies in this area, (such as the one by Pelc, Kornreich, Foisy, & Dan, 2006) this project did not include an instrument for identifying whether the participants

believed they were correct or not in their classifications, so potential performance biases could not be measured. In addition, disgust and surprise were not a part of the Emotion Recognition Task, unlike previous studies that also provide data on these emotions (including Boakes, Chapman, Houghton, & West, 2008; Pelc, Kornreich, Foisy, & Dan, 2006; and Singh et al. 1998). This limits the usefulness of the data, as including all six common emotions would allow for more holistic and informed conclusions as to the state of social functioning in the desired population. Given the parameters of other tasks that the children were completing during laboratory visits, they were required to stop taking any short or long term-acting stimulant medication for twenty-four to forty-eight hours, respectively. Therefore, unlike the study by William et al. (2008), this project was not able to measure and compare the effects of psychostimulant medication upon the participants' performance on the Emotion Recognition Task, or their social functioning and peer relations as measured by their parents and teachers.

### *Conclusion*

Although this project did not find a connection between facial emotion recognition and social functioning, it still provides beneficial information for parents, educators, psychologists, and other individuals who work with or study children with ADHD. The results presented will serve to further understanding of specific differences in emotion recognition abilities in children with and without ADHD. Several results are in contradiction to previously published outcomes, which only underlies the importance of focusing on these variables in order to best assist children with ADHD. It is the author's hope that this project will not only contribute to current knowledge on this disorder, but also provide questions and hypotheses for future researchers who wish to expand knowledge of social functioning in children with ADHD.

## References

- Abikoff, H. B., Jensen, P. S., Arnold, L. L. E., Hoza, B., Hechtman, L., Pollack, S., . . . Wigal, T. (2002). Observed classroom behavior of children with ADHD: Relationship to gender and comorbidity. *Journal of Abnormal Child Psychology*, *30*(4), 349-359.
- Adler, L. A. & Chua, H. C. (2002). Management of ADHD in adults. *The Journal of Clinical Psychiatry*, *63*(12), 29-35.
- Andrade, B. F., Waschbusch, D. A., Doucet, A., King, S., MacKinnon, M., McGrath, P. J., . . . Corkum, P. Social information processing of positive and negative hypothetical events in children with ADHD and conduct problems and controls. *Journal of Attention Disorders*, *16*(6), 491–504.
- Antrop, I. Roeyers, H., Oosterlaan, J., & Van Oost, P. (2002). Agreement between parent and teacher ratings of disruptive behavior disorders in children with clinically diagnosed ADHD. *Journal of Psychopathology and Behavioral Assessment*, *24*(1), 67.
- Barkley, R. A. (1988). The effects of methylphenidate on the interactions of preschool ADHD children with their mothers. *Journal of the American Academy of Child and Adolescent Psychiatry*, *27*(3), 336-341.
- Barkley, R. A. (2002). Major life activity and health outcomes associated with attention-deficit/hyperactivity disorder. *The Journal of Clinical Psychiatry*, *63*(12), 10-15.
- Barkley, R. A. (2004). Driving impairments in teens and adults with attention-deficit/hyperactivity disorder. *The Psychiatric Clinics of North America*, *27*(2), 233-260.
- Barkley, R. A., Fischer, M., Edelbrock, C. S., & Smallish, L. (1990). The adolescent outcome of



- hyperactive-children diagnosed by research criteria.1. An 8-year prospective follow-up-study. *Journal of the American Academy of Child and Adolescent Psychiatry*, 29(4), 546-557.
- Bauermeister, J. J., Shrout, P. E., Chavez, L., Rubio-Stipec, M., Ramirez, R., Padilla, L., . . . Canino, G. (2007). ADHD and gender: are risks and sequela of ADHD the same for boys and girls? *Journal of Child Psychology and Psychiatry*, 48(8), 831-839.
- Becker, K. B. & McCloskey, L. A. (2002). Attention and conduct problems in children exposed to family violence. *American Journal of Orthopsychiatry*, 72(1), 83-91.
- Berlin, L., Bohlin, G., & Rydell, A. M. (2003). Relations between inhibition, executive functioning, and ADHD symptoms: A longitudinal study from age 5 to 8-1/2 years. *Child Neuropsychology*, 9(4), 255-266.
- Bernardi, S., Faraone, S. V., Cortese, S., Kerridge, B. T., Pallanti, S., Wang, S., Blanco, C. (2012). The lifetime impact of attention deficit hyperactivity disorder: Results from the national epidemiologic survey on alcohol and related conditions (NESARC). *Psychological Medicine*, 42(4), 875-887.
- Biederman, J., Kwon, A., Aleardi, M., Chouinard, V. A., Marino, T., Cole, H., . . . Faraone, S. V. (2005). Absence of gender effects on attention deficit hyperactivity disorder: Findings in nonreferred subjects. *American Journal of Psychiatry*, 162(6), 1083-1089.
- Biederman, J., Mick, E., Faraone, S. V., Braaten, E., Doyle, A., Spencer, T., . . . Johnson, M. A. (2002). Influence of gender on attention deficit hyperactivity disorder in children referred to a psychiatric clinic. *American Journal of Psychiatry*, 159(1), 36-42.
- Biederman, J., Monuteaux, M. C., Doyle, A. E., Seidman, L. J., Wilens, T. E., Ferrero,

- F.,...Faraone, S. V. (2004). Impact of executive function deficits and attention-deficit/hyperactivity disorder (ADHD) on academic outcomes in children. *Journal of Consulting and Clinical Psychology, 72*(5), 757-766.
- Biederman, J. Petty, C. R., Evans, M., Small, J., & Faraone, S. V. (2010). How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Research, 177*(3), 299-304.
- Boakes, J., Chapman, E., Houghton, S., & West, J. (2008). Facial affect interpretation in boys with attention deficit/hyperactivity disorder. *Child Neuropsychology, 14*(1), 82-96.
- Booster, G. D., DuPaul, G. J., Eiraldi, R., & Power, T. J. (2012). Functional impairments in children with ADHD: Unique effects of age and comorbid status. *Journal of Attention Disorders 16*(3), 179-189.
- Braaten, E. B. & Rosen, L. A. (2000). Self-regulation of affect in attention deficit-hyperactivity disorder (ADHD) and non-ADHD boys: Differences in empathic responding. *Journal of Consulting and Clinical Psychology, 68*(2), 313-321.
- Brocki, K. C., & Bohlin, G. (2006). Developmental change in the relation between executive functions and symptoms of ADHD and co-occurring behaviour problems. *Infant and Child Development, 15*(1), 19-40.
- Brocki, K. C., Tillman, C. M., & Bohlin, G. (2010). CPT performance, motor activity, and continuous relations to ADHD symptom domains: A developmental study. *European Journal of Developmental Psychology, 7*(2), 178-197.
- Brod, M., Schmitt, E., Goodwin, M., Hodgkins, P., & Niebler, G. (2011). ADHD burden of illness in older adults: a life course perspective. *Quality of Life Research 21*(5), 795-799.
- Brown, M.B. (2000). Diagnosis and treatment of children and adolescents with attention-

- deficit/hyperactivity disorder. *Journal of Counseling and Development*, 78(2), 195-203.
- Bruchmuller, K., Margraf, J., & Schneider, S. (2012). Is ADHD diagnosed in accord with diagnostic criteria? Overdiagnosis and influence of client gender on diagnosis. *Journal of Consulting and Clinical Psychology*, 80(1), 128-138.
- Cardoos, S. L., & Hinshaw, S. P. (2011). Friendship as protection from peer victimization for and without ADHD. *Journal of Abnormal Child Psychology*, 39(7), 1035-1045.
- Chronis-Tuscano, A., Molina, B. S. G., Pelham, W. E., Applegate, B., Dahlke, A., Overmyer, M., & Lahey, B. B. (2010). Very early predictors of adolescent depression and suicide attempts in children with attention-deficit/hyperactivity disorder. *Archives of General Psychiatry*, 67(10), 1044-1051.
- Coles, E. K., Slavec, J., Bernstein, M., & Baroni, E. (2012). Exploring the gender gap in referrals for children with ADHD and other disruptive behavior disorders. *Journal of Attention Disorders*, 16(2), 101-108.
- Cunningham, C. E., & Boyle, M. H. (2002). Preschoolers at risk for attention-deficit hyperactivity disorder and oppositional defiant disorder: Family, parenting, and behavioral correlates. *Journal of Abnormal Child Psychology*, 30(6), 555-569.
- Cussen, A., Sciberras, E., Ukoumunne, O. C., & Efron, D. (2012). Relationship between symptoms of attention-deficit/hyperactivity disorder and family functioning: a community-based study. *European Journal of Pediatrics*, 171(2), 271-280.
- Da Fonseca, D., Seguier, V., Santos, A., Poinso, F., & Deruelle, C. (2009). Emotion understanding in children with ADHD. *Child Psychiatry & Human Development*, 40(1), 111-121.
- Davis, S. M., Katusic, S. K., Barbaresi, W. J., Killian, J., Weaver, A. L., Ottman, R., & Wirrell,

- E. C. (2010). Epilepsy in children with attention-deficit/hyperactivity disorder. *Pediatric Neurology*, 42(5), 325-330.
- Daviss, W. B. (2008). A review of co-morbid depression in pediatric ADHD: Etiologies, phenomenology, and treatment. *Journal of Child and Adolescent Psychopharmacology*, 18(6), 565-571.
- de Graaf, R., Kessler, R. C., Fayyad, J., ten Have, M., Alonso, J., Angermeyer, M., Borges, G.,...Posada- Villa, J. (2008). The prevalence and effects of adult attention-deficit/hyperactivity disorder (ADHD) on the performance of workers: Results from the WHO world mental health survey initiative. *Occupational and Environmental Medicine*, 65(12), 835-842.
- Dilsaver, S. C., Henderson-Fuller, S., & Akiskal, H. S. (2003). Occult mood disorders in 104 consecutively presenting children referred for the treatment of attention-deficit/hyperactivity disorder in a community mental health clinic. *The Journal of Clinical Psychiatry*, 64(10), 1170-1176.
- Dunn, D. W. & Kronenberger, W. G. (2003). Attention-deficit/hyperactivity disorder in children adolescents. *Neurologic Clinics*, 21(4), 933-940.
- Edel, M.-A., Rudel, A., Hubert, C., Scheele, D., Brüne, M., Juckel, G., & Assion, H-J. (2010). Alexithymia, emotion processing and social anxiety in adults with ADHD. *European Journal of Medical Research*, 15(9), 403-409.
- Ek, U., Westerlund, J., Holmberg, K., & Fernell, E. (2011). Academic performance of adolescents with ADHD and other behavioural and learning problems -a population-based longitudinal study Academic performance of adolescents with ADHD. *Acta pædiatrica*, 100(3), 402-406.

- Fischer, M., Barkley, R. A., Smallish, L., & Fletcher, K. (2002). Young adult follow-up of hyperactive children: Self-reported psychiatric disorders, comorbidity, and the role of childhood conduct problems and teen CD. *Journal of Abnormal Child Psychology*, *30*(5), 463-475.
- Froehlich, T. E., Lanphear, B. P., Auinger, P., Hornung, R., Epstein, J. N., Braun, J., & Kahn, R. S. (2009). Association of tobacco and lead exposures with attention-deficit/hyperactivity disorder. *Pediatrics*, *124*(6), 1054-1063.
- Froehlich, T. E., Lanphear, B. P., Epstein, J. N., Barbaresi, W. J., Katusic, S. K., & Kahn, R. S. (2007). Prevalence, recognition, and treatment of attention-deficit/hyperactivity disorder in a national sample of US children. *Archives of Pediatrics & Adolescent Medicine*, *161*(9), 857-864.
- Garcia, C. R., Bau, C. H. D., Silva, K. L., Callegari-Jacques, S. M., Salgado, C. A. I., Fischer, A. G.,... Grevet, E. H. (2012). The burdened life of adults with ADHD: Impairment beyond comorbidity. *European Psychiatry*, *27*(5), 309-313.
- Glass, K., Flory, K., & Hankin, B.L. (2010). Symptoms of ADHD and close friendships in adolescence. *Journal of Attention Disorders*, *16*(5), 406-417.
- Graziano, P. A., Geffken, G. R., & McNamara, J. P. (2011). Atypical behaviors and comorbid externalizing symptoms equally predict children with attention-deficit/hyperactivity disorder's social functioning. *Child Psychiatry and Human Development*, *42*(4), 377-389.
- Gunther, T., Jolles, J., Herpertz-Dahlmann, B., & Konrad, K. (2009). Age-Dependent differences in attentional processes in ADHD and disruptive behavior disorder. *Developmental Neuropsychology*, *34*(4), 422-434.
- Halperin, J. M., Trampush, J. W., Miller, C. J., Marks, D. J., & Newcorn, J. H. (2008).

- Neuropsychological outcome in adolescents/young adults with childhood ADHD: profiles of persisters, remitters and controls. *Journal of Child Psychology and Psychiatry*, 49(9), 958-966.
- Hanc, T. & Brzezinska, A. I. (2009). Intensity of ADHD symptoms and subjective feelings of competence in school age children. *School Psychology International*, 30(5), 491-506.
- Hantson, J., Wang, P. P., Grizenko-Vida, M., Ter-Stepanian, M., Harvey, W., Jooper, R.,... Grizenko, N. (2011). Effectiveness of a therapeutic summer camp for children with ADHD : Phase I clinical intervention trial. *Journal of Attention Disorders*, 16(7), 610-617.
- Hasson, R., & Fine, J. G. (2012). Gender differences among children with ADHD on continuous performance tests: A meta-analytic review. *Journal of Attention Disorders*, 16(3), 190-198.
- Huang-Pollock, C. L., Mikami, A. Y., Pfiffner, L., McBurnett, K. (2009). Can executive functions explain the relationship between attention deficit hyperactivity disorder and social adjustment?. *Journal of Abnormal Child Psychology*, 37(5), 679-691.
- Jack, A., Mikami, A. Y., & Calhoun, C. D. (2011). The moderating role of verbal aggression on the relationship between parental feedback and peer status among children with ADHD. *Journal of Abnormal Child Psychology*, 39(7), 1059-1071.
- Jackson, D. A., & King, A. R. (2004). Gender differences in the effects of oppositional behavior on teacher ratings of ADHD symptoms. *Journal of Abnormal Child Psychology*, 32(2), 215-224.
- Kaiser, N. M., McBurnett, K., & Pfiffner, L. J. (2010). Child ADHD severity and positive and

- negative parenting as predictors of child social functioning: Evaluation of three theoretical models. *Journal of Attention Disorders*, 15(3), 193-203.
- Kats-Gold, I., Besser, A., & Priel, B. (2007). The role of simple emotion recognition skills among school aged boys at risk of ADHD. *Journal of Abnormal Child Psychology*, 35(3), 363-378.
- Kawabata, Y., Tseng, W.-L., & Gau, S. S.-F. (2012). Symptoms of attention-deficit/hyperactivity disorder and social and school adjustment: The moderating roles of age and parenting. *Journal of Abnormal Child Psychology*, 40(2), 177-188.
- Kofler, M. J., Rapport, M. D., Bolden, J., Sarver, D. E., Raiker, J. S., & Alderson, R. M. (2011). Working memory deficits and social problems in children with ADHD. *Journal of Abnormal Child Psychology*, 39(6), 805-817.
- Kowalski, R. M., & Fedina, C. (2011). Cyber bullying in ADHD and asperger syndrome populations. *Research in Autism Spectrum Disorders*, 5(3), 1201-1208.
- Langberg, J. M., Epstein, J. N., Altaye, M., Molina, B. S. G., Arnold, L. E., & Vitiello, B. (2008). The transition to middle school is associated with changes in the developmental trajectory of ADHD symptomatology in young adolescents with ADHD. *Journal of Clinical Child and Adolescent Psychology*, 37(3), 651-663.
- Lee, S. S., Falk, A. E., & Aguirre, V. P. (2012). Association of comorbid anxiety with social functioning in school-age children with and without attention-deficit/hyperactivity disorder (ADHD). *Psychiatry Research*, 197(1-2), 90-96.
- Levy, F., Hay, D. A., Bennett, K. S., & McStephen, M. (2005). Gender differences in ADHD subtype comorbidity. *Journal of the American Academy of Child and Adolescent Psychiatry*, 44(4), 368-376.

- Loe, I. M. & Feldman, H. M. (2007). Academic and educational outcomes of children with ADHD. *Journal of Pediatric Psychology, 32*(6), 643-654.
- Matthies, S., van Elst, L. T., Feige, B., Fischer, D., Scheel, C., Krogmann, E.,... Philipsen, A. (2011). Severity of childhood attention-deficit hyperactivity disorder-A risk factor for personality disorders in adult life?. *Journal of Personality Disorders, 25*(1), 101-114.
- McConaughy, S. H. & Volpe, R. J. (2011). Academic and social impairments of elementary school children with attention deficit hyperactivity disorder. *School Psychology Review, 40*(2), 200-225.
- Miller, M., Nevado-Montenegro, A. J., & Hinshaw, S. P. (2012). Childhood executive function continues to predict outcomes in young adult females with and without childhood-diagnosed ADHD. *Journal of Abnormal Child Psychology, 40*(5), 657-668.
- Mitsis, E. M., McKay, K. E., Schulz, K. P., Newcorn, J. H., & Halperin, J.M. (2000). Parent-teacher concordance for DSM-IV attention-deficit/hyperactivity disorder in a clinic-referred sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*(3), 308-313.
- Motlagh, M. G., Sukhodolsky, D. G., Landeros-Weisenberger, A., Katsoyich, L., Thompson, N., Scahill, L.,...Leckman, J. F. (2011). Adverse effects of heavy prenatal maternal smoking on attentional control in children with ADHD. *Journal of Attention Disorders, 15*(7), 593-603.
- Murray-Close, D., Hoza, B., Hinshaw, S. P., Arnold, L. E., Swanson, J., Jensen, P. S.,... Wells, K. (2010). Developmental processes in peer problems of children with attention-deficit/hyperactivity disorder in The multimodal treatment study of children with ADHD:



- Developmental cascades and vicious cycles. *Development and Psychopathology*, 22(4), 785-802.
- Nolan, E. E., Volpe, R. J., Gadow, K. D., & Sprafkin, J. (1999). Developmental, gender, and comorbidity differences in clinically referred children with ADHD. *Journal of Emotional and Behavioral Disorders*, 7(1), 11-20.
- Normand, S., Schneider, B. H., Lee, M. D., Maisonneuve, M-F., Kuehn, S. M., & Robaey, P. (2011). How do children with ADHD (mis)manage their real-life dyadic friendships? A multi-method investigation. *Journal of Abnormal Child Psychology*, 39(2), 293-305.
- Ohlmeier, M. D., Peters, K., Te Wildt, B. T., Zelder, M., Ziegenbein, M., Wiese, B.,...Schneider, U. (2008). Comorbidity of alcohol and substance dependence with attention-deficit/hyperactivity disorder (ADHD). *Alcohol and Alcoholism*, 43(3), 300-304.
- Owens, J. A., Maxim, R., Nobile, C., McGuinn, M., & Msall, M. (2000). Parental and self-report of sleep in children with attention-deficit/hyperactivity disorder. *Archives of Pediatrics & Adolescent Medicine*, 154(6), 549-555.
- Pelc, K., Kornreich, C., Foisy, M. L., & Dan, B. (2006). Recognition of emotional facial expressions in attention-deficit hyperactivity disorder. *Pediatric Neurology*, 35(2), 93-97.
- Petersen, B. D., & Grahe, J. E. (2012). Social perception and cue utilization in adults with ADHD. *Journal of Social and Clinical Psychology*, 31(7), 663-689.
- Rader, R., McCauley, L., & Callen, E. C. (2009). Current strategies in the diagnosis and treatment of childhood attention-deficit/hyperactivity disorder. *American Family Physician*, 79(8), 657-665.
- Rapport, L. J., Friedman, S. L., Tzelepis, A., & Van Voorhis, A. (2002). Experienced emotion

- and affect recognition in adult attention-deficit hyperactivity disorder. *Neuropsychology*, 16(1), 102-110.
- Redmond, S. M. (2011). Peer victimization among students with specific language impairment, attention-deficit/hyperactivity disorder, and typical development. *Language, Speech and Hearing Services in Schools*, 42(4), 520-535.
- Rodriguez, A., & Bohlin, G. (2005). Are maternal smoking and stress during pregnancy related to ADHD symptoms in children?. *Journal of Child Psychology and Psychiatry*, 46(3), 246-254.
- Sarawate, C. A., & Hankin, C. (2003). Gender variation in quality of pharmacologic care of children diagnosed with attentiondeficit/hyperactivity disorder (ADHD). *Value in Health*, 6(3), 185-186.
- Schmidt, S., & Petermann, F. (2009). Developmental psychopathology: Attention deficit hyperactivity disorder (ADHD). *BMC Psychiatry*, 9(58).
- Sciberras, E., Ohan, J., & Anderson, V. (2012). Bullying and peer victimisation in adolescent girls with attention-deficit/hyperactivity disorder. *Child Psychiatry and Human Development*, 43(2), 254-270.
- Sciutto, M. J., Nolfi, C. J., & Bluhm, C. (2004). Effects of child gender and symptom type on referrals for ADHD by elementary school teachers. *Journal of Emotional and Behavioral Disorders*, 12(4), 247-253.
- Semrud-Clikeman, M. (2010). The role of inattention and social perception and performance in two subtypes of ADHD. *Archives of Clinical Neuropsychology*, 25(8), 771-780.
- Shilon, Y., Pollack, Y., Aran, A., Shaked, S., & Gross-Tsur, V. (2012). Accidental injuries are

- more common in children with attention deficit hyperactivity disorder compared with their non-affected siblings. *Child: Care, Health & Development*, 38(3), 366-370.
- Sibley, M. H., Pelham, W. J., Molina, B. S. G., Gnagy, E. M., Waschbusch, D. A., Garefino, A. C.,...Karch, K. M. (2012). Diagnosing ADHD in adolescence. *Journal of Consulting and Clinical Psychology*, 80(1), 139-150.
- Siddique, S., Banarjee, M., Ray, M. J., & Lahiri, T. (2011). Attention-deficit hyperactivity disorder in children chronically exposed to high level of vehicular pollution. *European Journal of Pediatrics*, 170(7), 923-929.
- Singh, S. D., Ellis, C. R., Winton, A. S. W., Singh, N. N., Leung, J. P., & Oswald, D. P. (1998). Recognition of facial expressions of emotion by children with Attention-Deficit Hyperactivity Disorder. *Behavior Modification*, 22(2), 128-142.
- Sinzig, J., Morsch, D., & Lehmkuhl, G. (2008). Do hyperactivity, impulsivity and inattention have an impact on the ability of facial affect recognition in children with autism and ADHD? *European Child & Adolescent Psychiatry*, 17(2), 63-72.
- Smith, B. H., Molina, B. S. G., & Pelham, W. E. (2002). The clinically meaningful link between alcohol use and attention deficit hyperactivity disorder. *Alcohol Health and Research World*, 26(2), 122-129.
- Sowerby, P., Seal, S., & Tripp, G. (2011). Working memory deficits in ADHD: The contribution of age, learning/language difficulties, and task parameters. *Journal of Attention Disorders*, 15(6), 461-472.
- Spencer, T. J., Biederman, J., & Mick, E. (2007). Attention-deficit/hyperactivity disorder: Diagnosis, lifespan, comorbidities, and neurobiology. *Ambulatory Pediatrics: The Official Journal of the Ambulatory Pediatric Association*, 7(1), 73-81.

- Sprung, J., Flick, R. P., Katusic, S. K., Colligan, R. C., Barbaresi, R. J., Bojanic, K.,... Warner, D. O. (2012). Attention-deficit/hyperactivity disorder after early exposure to procedures requiring general anesthesia. *Mayo Clinic Proceedings*, *87*(2), 120-129.
- Thunstrom, M. (2002). Severe sleep problems in infancy associated with subsequent development of attention-deficit/hyperactivity disorder at 5.5 years of age. *Acta Paediatrica*, *91*(5), 584-592.
- Tillman, C., Eninger, L., Forssman, L., & Bohlin, G. (2011). The relation between working memory components and ADHD symptoms from a developmental perspective. *Developmental Neuropsychology*, *36*(2), 181-198.
- Willcutt, E. G. & Pennington, B. F. (2000a). Comorbidity of reading disability and attention-deficit/hyperactivity disorder: Differences by gender and subtype. *Journal of Learning Disabilities*, *33*(2), 179-191.
- Willcutt, E.G., Pennington, B. F., & DeFries, J. C. (2000b). Etiology of inattention and hyperactivity/impulsivity in a community sample of twins with learning difficulties. *Journal of Abnormal Child Psychology*, *28*(2), 149-159.
- Willcutt, E.G., Pennington, B. F., & DeFries, J. C. (2000c). Twin study of the etiology of comorbidity between reading disability and attention-deficit/hyperactivity disorder. *American Journal of Medical Genetics*, *96*(3), 293-301.
- Williams, L. M., Hermens, D. F., Palmer, D., Kohn, M., Clarke, S., Keage, H., . . . Gordon, E. (2008). Misinterpreting emotional expressions in attention-deficit/hyperactivity disorder: Evidence for a neural marker and stimulant effects. *Biological Psychiatry*, *63*(10), 917-926.
- Yuill, N., & Lyon, J. (2007). Selective difficulty in recognising facial expressions of emotion in

boys with ADHD - General performance impairments or specific problems in social cognition? *European Child & Adolescent Psychiatry*, 16(6), 398-404.

**Appendix***Table 1. Participant Characteristics (Gender and ADHD or Control Status)*

	<b>Male</b>	<b>Female</b>
<b>ADHD</b>	79	50
<b>Control</b>	31	32

Table 2. One Way ANOVA of POFA Measures by ADHD Status

	<b>ADHD (n=129)</b>	<b>Control (n=63)</b>	
<b>Measure</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>F</b>
POFA RT to happy faces	1542.16 (327.06)	1417.14 (277.48)	$F(1,190) = 6.808, p = 0.010, \eta_p^2 = 0.035$
POFA RT to sad faces	1992.32 (501.67)	1842.79 (329.91)	$F(1,190) = 4.304, p = 0.039, \eta_p^2 = 0.022$
POFA RT to scared faces	1956.88 (417.89)	1853.20 (420.06)	$F(1,190) = 2.597, p = 0.109, \eta_p^2 = 0.013$
POFA RT to angry faces	1972.34 (458.03)	1857.92 (448.29)	$F(1,190) = 2.678, p = 0.103, \eta_p^2 = 0.014$
POFA accuracy to happy faces	9.38 (1.01)	9.76 (1.653)	$F(1,190) = 3.916, p = 0.049, \eta_p^2 = 0.020$
POFA accuracy to sad faces	6.98 (1.88)	7.62 (1.73)	$F(1,190) = 5.219, p = 0.023, \eta_p^2 = 0.027$
POFA accuracy to scared faces	8.02 (1.70)	8.37 (2.05)	$F(1,190) = 1.493, p = 0.223, \eta_p^2 = 0.008$
POFA accuracy to angry faces	7.44 (1.94)	7.94 (1.46)	$F(1,190) = 3.207, p = 0.075, \eta_p^2 = 0.017$

Note: POFA=Pictures of Facial Affect; RT=Reaction Time

Table 3. One Way ANOVA of POFA Measures by Gender

	<b>Male (n=110)</b>	<b>Female (n=82)</b>	
<b>Measure</b>	<b>M (SD)</b>	<b>M (SD)</b>	<b>F</b>
POFA RT to happy faces	1503.00 (304.53)	1498.64 (333.66)	$F(1,190) = 0.009, p = 0.925, \eta_p^2 = 0.000$
POFA RT to sad faces	1961.52 (458.04)	1918.75 (494.12)	$F(1,190) = 0.383, p = 0.537, \eta_p^2 = 0.002$
POFA RT to scared faces	1957.88 (426.33)	1875.86 (410.05)	$F(1,190) = 1.796, p = 0.182, \eta_p^2 = 0.009$
POFA RT to angry faces	1956.54 (435.20)	1905.61 (485.60)	$F(1,190) = 0.582, p = 0.446, \eta_p^2 = 0.003$
POFA accuracy to happy faces	9.46 (0.90)	9.56 (1.63)	$F(1,190) = 0.277, p = 0.599, \eta_p^2 = 0.001$
POFA accuracy to sad faces	7.18 (1.69)	7.19 (2.04)	$F(1,190) = 0.002, p = 0.961, \eta_p^2 = 0.000$
POFA accuracy to scared faces	7.97 (1.76)	8.35 (1.88)	$F(1,190) = 2.064, p = 0.152, \eta_p^2 = 0.011$
POFA accuracy to angry faces	7.68 (1.78)	7.5 (1.84)	$F(1,190) = 0.474, p = 0.492, \eta_p^2 = 0.002$

Note: POFA = Pictures of Facial Affect, RT=Reaction Time



*Table 4. Correlations between Participants Age, PSSRS, TPRS and POFA Measures*

<b>Measure</b>	<b>Age</b>	<b>PSSRS</b>	<b>TPRS</b>
POFA RT to happy faces	-0.19**	-0.05	-0.08
POFA RT to sad faces	-0.18**	-0.04	-0.08
POFA RT to scared faces	-0.11	-0.13	-0.07
POFA RT to angry faces	-0.01	-0.03	0.02
POFA accuracy to happy faces	0.04	0.10	0.07
POFA accuracy to sad faces	0.04	0.06	0.03
POFA accuracy to scared faces	0.12	0.04	0.08
POFA accuracy to angry faces	0.09	0.07	-0.01

Note: PSSRS=Parent Social Skills Rating Scale, TPRS=Teacher Peer Relations Scale, POFA=Pictures of Facial Affect, RT=Reaction Time

\*\* = Correlation is significant at the 0.01 level (2-tailed)

\*= Correlation is significant at the 0.05 level (2-tailed).

Table 5. Linear Regression Analysis – Age and POFA Measures

	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$	$r^2\Delta$
Block 1	POFA RT to happy faces	POFA RT to sad faces	POFA RT to scared faces	POFA RT to angry faces	POFA accuracy to happy faces	POFA accuracy to sad faces	POFA accuracy to scared faces	POFA accuracy to angry faces
<i>ADHD</i>	0.035*	0.022*	0.013	0.014	0.020*	0.027*	0.008	0.017
Block 2								
<i>Age</i>	0.030*	0.030*	0.011	0.000	0.001	0.001	0.014	0.007
Block 3								
<i>Interaction</i>	0.001	0.000	0.005	0.008	0.016	0.001	0.003	0.001

Note: POFA = Pictures of Facial Affect, RT=Reaction Time; \* $p < .05$

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