The Relationship Between Visual Attention and Emotion Knowledge in Children with Attention-Deficit Hyperactivity Disorder

A thesis presented to

the faculty of

the College of Arts and Sciences of Ohio University

In partial fulfillment

of the requirements for the degree

Master of Science

Verenea J. Serrano

May 2014

© 2014 Verenea J. Serrano. All Rights Reserved.

This thesis titled

The Relationship Between Visual Attention and Emotion Knowledge in Children with Attention-Deficit Hyperactivity Disorder

by

VERENEA J. SERRANO

has been approved for

the Department of Psychology

and the College of Arts and Sciences by

Julie S. Owens

Associate Professor of Psychology

Robert Frank

Dean, College of Arts and Sciences

ABSTRACT

SERRANO, VERENEA J., M.S., May 2014, Psychology

The Relationship Between Visual Attention and Emotion Knowledge in Children with Attention-Deficit Hyperactivity Disorder

Director of Thesis: Julie S. Owens

In the current study, eye-tracking technology was used in conjunction with emotion knowledge (EK) tasks to examine the relationship between visual attention and EK accuracy in children with and without ADHD. Participants were 45 children (60% male) between the ages of 8 and 12; 19 of whom met DSM-IV criteria for Attention-Deficit/Hyperactivity Disorder (ADHD) and 26 of whom did not. EK was assessed via performance on emotion recognition tasks using images of facial expressions and images of situations where the child was required to infer emotion from the context. Visual attention was measured via an eye-tracking system that recorded visual fixations while the children viewed the images. Contrary to the hypotheses, there were no significant differences between groups on EK accuracy or visual attention across the two image sets. However, small to medium effect sizes were observed (Cohen's d = -0.73 – 0.35), suggesting that, in some cases, children with ADHD are less accurate in identifying emotions and spend less time viewing relevant areas of images compared to children without ADHD. Regression analyses were conducted to examine whether parent and teacher ratings of inattention or visual attention better predict EK and social competence. These measures of inattention/attention did not predict EK accuracy; however, teacher-rated inattention predicted teacher-rated social competence. Additional research examining EK and visual attention across stimuli types and settings is needed to help

understand the relationship between these constructs in children with ADHD. Implications of the findings are discussed in the context of previous research and the current study's sample characteristics.

ACKNOWLEDGMENTS

Assistance for this project came from multiple sources, including my advisor, Dr. Julie Owens, our collaborator, Dr. Brooke Hallowell, and dedicated research assistants who helped make the project happen. I would like to acknowledge each of their contributions and support through the process.

TABLE OF CONTENTS

Page

Abstract 3
Acknowledgments 5
List of Tables 8
Introduction 9
Emotion Knowledge and Related Constructs 11
Emotion Knowledge and Social Competence in Typically-Developing Children 12
Emotion Knowledge in Persons with ADHD 13
Emotion Recognition Deficits in Children with ADHD 13
Emotion Recognition Deficits in Adults with ADHD 15
Situational Emotion Knowledge Deficits in Children with ADHD 16
Social Competence in Children with ADHD 19
Emotion Knowledge and Social Competence in Children with ADHD 20
Purported Contributors to Emotion Knowledge Deficits in Children with ADHD 22
Face and Scene Perception with Eye-Tracking 26
Current Study 28
Method 29
Participants 29
Measures 30
Cognitive ability 30
Diagnostic interview 30
ADHD and ODD symptoms 30
Impairment 31
Social competence 31
Eye-Tracking Apparatus and EK Stimuli 32
Pictures of Facial Affect (POFA; Ekman and Friesen, 1975) 32
Internet Images 33
Pilot Testing of Internet Images 34
Procedure 36
Results 38

Data Preparation 38
Analytic Plan 39
Hypothesis A: Children with ADHD will have lower EK accuracy scores when viewing emotion stimuli compared to control children 40
Hypothesis B: Children with ADHD will have a lower proportion of time that they view relevant areas of emotion stimuli compared to control children 41
Hypothesis C: Proportion of time spent viewing relevant areas will be a stronger predictor of EK and social competence than parent and teacher ratings of inattention 42
Discussion 44
Limitations and Future Directions 50
Summary 52
References 54
Appendix A: Parent Report Measures 72
Disruptive Behavior Disorders Rating Scale- Parent Report 72
Impairment Rating Scale- Parent Report 74
Social Skills Improvement System Rating Scale- Parent Report 76
Appendix B: teacher Report Measures 77
Disruptive Behavior Disorders Rating Scale- Teacher Report 77
Impairment Rating Scale- Teacher Report 79
Social Skills Improvement System Rating Scale- Teacher Report 81
Appendix C: Eye-Tracking Stimuli 82
Appendix D: Phone Screen 83
Appendix E: Consent and Assent Forms 87
Teacher Consent Form 87
Parent Consent Form 89
Child Assent Form 93

LIST OF TABLES

Page

Table 1: Summary of Studies Examining Emotion Recognition in Children With ADHD 62

Table 2: Studies Examining Situational Emotion Knowledge in Children with ADHD 65

Table 3: Sample Characteristics 66

Table 4: Stimuli Images Descriptions 67

Table 5: EK Task Performance and Relevant Area Gaze Duration Values 69

Table 6: Correlations Between Demographic, EK, and Eye-Tracking Variables 70

Table 7: Hierarchical Linear Regression Results for EK Accuracy and AOI Gaze Duration 71

INTRODUCTION

On a daily basis individuals are required to recognize emotions in the facial expressions and body language of others, to recognize their own emotions, and to understand how emotions can affect situations. These skills represent emotion knowledge (EK). Among typically developing children, greater EK is related to greater social competence, fewer behavioral problems, and less peer rejection (Izard et al., 2008; Miller et al., 2005). EK is also positively correlated with emotion regulation, and is considered by some to be a major factor in the development of emotion regulation (Izard et al., 2008; 2011). Children with attention-deficit hyperactivity disorder (ADHD) often exhibit deficits in EK and these deficits are related to impaired social competence (Kats-Gold, Besser, & Priel, 2007; Kats-Gold & Priel, 2009). The documented EK deficits in children with ADHD include decreased accuracy in recognizing emotion in facial expressions and in understanding the role of emotion in situations (Cadesky, Mota, & Schachar, 2000). Given the relationship between EK and social competence, EK deficits may, in part, cause or exacerbate the social impairment and peer rejection commonly experienced by children with ADHD (for review, see Barkley, 2006; Hoza et al., 2005).

Factors contributing to EK deficits in ADHD are still unknown, however researchers have hypothesized that inattention is a primary contributor. In the autism spectrum disorder (ASD) literature, researchers have used eye-tracking technology to identify visual fixation patterns to emotion and social stimuli that differentiate between those with an ASD and those without an ASD (Pierce, Conant, Hazin, Stoner, & Desmond, 2011). Though the nature of the social impairment differs between ASDs and ADHD, the ASD literature demonstrates the utility of eye-tracking in understanding the

role of visual attention in social deficits in children with social impairment. Eye-tracking offers the opportunity to examine inattention, a purported primary contributor to EK deficits in ADHD. However, despite its potential utility, the use of eye-tracking technology in examining EK in children with ADHD has been limited.

In the present study eye-tracking technology was used to examine the visual attention of children with and without ADHD while they viewed images of facial expressions with and without context to investigate (a) if children with and without ADHD differ in their EK accuracy, (b) if children with and without ADHD differ in proportion of time they view relevant (versus irrelevant) areas of emotion stimuli, and (c) which indicators of inattention (parent and teacher rating of inattention or viewing time of relevant areas) better predict EK and social competence. The potential long-term negative impact that EK deficits can have in children with ADHD, as well as the limited effectiveness of current interventions to address social impairment in children with ADHD (Hoza, 2007), underscore the importance of understanding the factors contributing to these deficits. A better understanding of the contributors to EK deficits could inform the development or modification of interventions so as to directly target the factors contributing to EK deficits in ADHD and potentially improve the social and emotional functioning in individuals with ADHD. In the pages that follow, EK and related constructs are defined, the literatures on EK and social competence in typically-developing children and children with ADHD are reviewed, and the potential utility of eye-tracking in understanding EK deficits in ADHD is discussed.

EMOTION KNOWLEDGE AND RELATED CONSTRUCTS

EK is a subcomponent of the larger construct of emotional competence, which is a vital part of healthy development that is linked to academic achievement and pro-social behavior (Izard et al., 2001; Miller et al., 2005). Deficits in emotional competence skills are related to peer rejection and problematic behavior (Curtis & Norgate, 2007; Miller et al., 2005). Emotional competence is comprised of three components: emotion regulation, emotion expression, and EK (Denham, 1998; Saarni, 1999). Emotion regulation is the ability to manage the internal experience of and external expression of emotions in one's self. Emotion expression is the manner in which emotions are communicated to others. EK is the recognition and understanding of emotion. EK includes the ability to identify emotions in one's self and others (emotion recognition), to infer the cause and effect of emotion in situations (situational emotion knowledge), and understand that the emotions of self and others may differ. For example, when seeing a sports player cry after losing a game, recognizing that the player is sad, and inferring that losing the game is likely what caused the sad emotion would require EK. The terms EK and emotion understanding are both used in the literature, and the terms reflect the same construct.

EMOTION KNOWLEDGE AND SOCIAL COMPETENCE IN TYPICALLY-DEVELOPING CHILDREN

Research indicates that children's EK is related to their social competence, including their peer-rated likeability and teacher-rated social skills (Denham et al., 2003; Izard et al., 2001; Miller et al., 2005*).* Izard and colleagues (2001) assessed EK in preschoolers via a facial-expression-picture-and-emotion-word matching task and a picture labeling task. EK at age 5 predicted teacher-rated social skills, academic competence, and problem behaviors at age 9, accounting for 6-9% of the variance in these outcomes after controlling for gender, verbal ability, and temperament. Miller et al. (2005) examined EK, (assessed via a spontaneous emotion word production task and an emotion/facial expression picture labeling task), and its relationship to peer sociometric ratings and to self-report of rejection and victimization in a sample of kindergarten and 1st grade children. Children with greater EK were more likely to receive positive peer nominations and less likely to report victimization or rejection. Additionally, EK in the Fall accounted for an additional 3-4% of the variance in Spring outcomes beyond that accounted for by grade level and the Fall outcome measurements.

Given the relationship between EK and social competence in typically-developing children, for children who have social problems, EK deficits may predate or exacerbate pre-existing social problems. Children with ADHD often have EK deficits and social impairment. Examining factors that affect EK in children with ADHD may help identify future targets for social interventions for this population.

Emotion Recognition Deficits in Children with ADHD

The author is aware of 12 studies that have examined the emotion recognition subcomponent of EK in children with ADHD (see Table 1). With the exception of Kats-Gold & Priel (2009) who included boys at-risk for ADHD, all of these referenced studies included children diagnosed with ADHD and a control group without any psychiatric diagnoses. Cadesky et al. (2000) also included a conduct problems only group and an ADHD with conduct problems group, and Casey (1996) also included children with Oppositional Defiant Disorder (ODD), Conduct Disorder (CD), and "a combination of disorders."

Collectively, these studies provide evidence that children with ADHD exhibit deficits in facial expression recognition for one or more emotion (Corbett & Glidden, 2000; Miller et al., 2011; Pelc et al., 2006; Rapport et al., 2002; Sinzig et al., 2008), in identifying emotions in themselves and others (Casey, 1996; Norvilitis, Casey, Brooklier, & Bonello, 2000), and in overall understanding of emotion (Kats-Gold & Priel, 2009).

However, there are several inconsistencies in the pattern of results across studies (see Table 1). These inconsistencies may be related to the wide variety of stimuli used, the wide variety of response formats used, and the different number of emotions assessed. First, some researchers used standardized measures or visual stimuli sets to test EK, whereas others used author-developed stimuli. Second, response format varied from free response to forced-choice picture and word matching, with one to seven options. Third, the number of trials per emotion ranged from 3 to 12. Fourth, some researchers tested all six primary emotions (i.e., happy, sad, angry, fearful, surprised, disgusted), whereas

others used a subset of these emotions. Fifth, ceiling effects were reported in a few of the studies and other studies did not report whether ceiling effects were present. The reported ceiling effects and potential of unreported ceiling effects raise the possibility that stimuli were not sufficiently difficult to detect group differences. Additionally, accuracy rates for the emotions differed across studies. It is unclear if this variability is to do methodological differences across the studies or if EK deficits in children with ADHD are not as pervasive or permanent as some studies suggest (i.e. those with significant effects).

Because different formats of stimuli have been used in EK studies with children with ADHD, Boakes and colleagues (2008) examined EK across different formats to determine the effect of stimuli format on group differences in EK. A stimuli set was created that contained photographs of cartoon character facial expressions, real-life facial expressions, static pictures, dynamic facial expressions (2-3 second video clip), and dynamic facial expression with context (10 second video clip) (Boakes, Chapman, Houghton, & West, 2008). Interestingly, there were no interactions between group (ADHD or control) and the stimulus variations (real-life vs. cartoon, static vs. dynamic), thus the authors averaged the scores across all the stimuli formats to produce six overall scores, one for each emotion. These results suggest that stimuli type may not affect emotion recognition. The emotion total scores indicated that children with ADHD were less accurate than control children in identifying fear and disgust (d = -0.64 and -0.73, respectively). Differences in identifying happiness, sadness, or anger were not significant (d range: -0.34 to -0.08); however, the authors discuss the possibility of ceiling effects for these emotions. The potential ceiling effects seen in this and other studies (see Table 1)

suggest that using more difficult stimuli may increase the chance of detecting potential group differences.

Emotion Recognition Deficits in Adults with ADHD

The EK deficits documented in children with ADHD are also present in adults with ADHD, and the results of the studies with adults shed light on factors that may contribute to EK deficits in children. Miller and colleagues (2011) measured EK (via the Diagnostic Analysis of Nonverbal Accuracy; DANVA; Nowicki & Duke, 1994) in adults and found a main effect for fearful errors, with post-hoc analyses showing that the ADHD-Inattentive group made more errors than the control group (d = .93); no difference was observed between the ADHD-Combined and control groups (d = 0.37) (Miller, Hanford, Fassbender, Duke, & Schweitzer, 2011). Regression analyses indicated that self-rated scores for inattention (step 1) and hyperactivity-impulsivity (step 2) were related to sad errors (R^2 = .10, p = .014); inattentive symptoms were positively related to number of sad errors (β = 0.54, p = .01), and hyperactive-impulsive symptoms were negatively related to the number of sad errors (β = -0.53, p = .01). When only inattention symptoms were in the model, inattention symptoms also predicted fearful errors (R^2 = .05; p = .03) and prosody task errors (R^2 = .05; p = .04). However, correlation statistics were not reported, thus whether suppressor effects were present in the regressions cannot be evaluated. Although, cause cannot be inferred from these cross sectional data, the results indicate that inattention symptoms may play a role in EK accuracy.

Another study found that adults with ADHD performed worse than adults in the control group in labeling emotions on the child faces (d = -0.59) and voices subtests (d = -0.81) of the DANVA (Rapport, Friedman, Tzelepis, & Van Voorhis, 2002). The Pictures

of Facial Affect (POFA; Ekman & Friesen, 1975) image set was also used, and results indicated that the ADHD group was less accurate than the control group in labeling happy (d = -0.65), angry (d = -0.73), and fearful (d = -0.95). Authors also included an animal recognition task (e.g., birds, fish) that was identical in design to the emotion recognition task. No group differences were found for recognition of any of the six animal groups. Given that the lack of group differences cannot be explained by ceiling effects for the task, this suggests that the emotional nature of the emotion recognition task contributed to group differences rather than difficulty understanding or completing the recognition task itself. Together, these two studies highlight that EK deficits are present in adults with ADHD, that recognition of emotion content is different than recognition of non-emotion content, and that inattention may play an important role in EK deficits.

The studies reviewed thus far suggest that persons with ADHD show deficits in the emotion recognition component of EK. In the next section, studies examining the situational emotion knowledge component of EK are discussed.

Situational Emotion Knowledge Deficits in Children with ADHD

Children with ADHD also show deficits in situational emotion knowledge, the ability to infer the cause and effect of emotion in situations (see Table 2 for summary of studies). Using the Kusche Affective Interview-Revised (KAI-R; Kusche, Greenberg, & Beilke 1988), Kats-Gold and Priel (2009) found that boys at-risk for ADHD had lower situational emotion knowledge scores than boys in the control group, as indicated by their decreased ability to answer questions related to how emotions can change in general and across a situation (d = 0.57). Similarly, Yuill and Lyon (2007) found that when children were read a scenario, the control group was more accurate than the ADHD group in

identifying which emotion was represented in the scenario (d = -1.98). Further, when the test was repeated with a second sample of children with ADHD and a younger control group, the ADHD group was less accurate than the younger control group (d = -0.89), suggesting that the situational emotion knowledge abilities of children with ADHD are less developed than would be expected for their age. Da Fonseca et al. (2009) assessed situational emotion knowledge via a task that required children to use context of an image to identify the emotion of a person in the image whose face was obscured. On this task, children in the ADHD group made more errors than children in the control group (d = 0.88). Participants also completed a similar, non-emotion, object task; group differences were not found for this task (the presence of task ceiling effects cannot be determined from the data reported). Further, accuracy scores of children in the control group did not differ between the object and emotion tasks. In contrast, children with ADHD were less accurate on the emotion task than on the object task. These results are consistent with Rapport and colleagues' (2002) findings that adults in the ADHD group were less accurate on the EK task than on the non-emotion task, whereas this task difference was not observed for adults in the control group. These findings suggest that the emotional aspect of the tasks contributed to decreased accuracy in children with ADHD, rather than an aspect of the task (e.g., cognitive or attention demands).

Taken together, results suggest that children with ADHD demonstrate impaired situational emotion knowledge, have a less developed understanding of how context influences emotions compared to typical children, and are less able to use context to aid emotion identification compared to same-aged and younger children. These impairments

in situational emotion knowledge have implications for the social interactions of children with ADHD.

SOCIAL COMPETENCE IN CHILDREN WITH ADHD

Impairment in social functioning in children with ADHD is well-documented (for reviews, see Barkley, 2006), affects a large percentage of children with ADHD (Pelham & Bender, 1982), and often results in greater rates of peer rejection compared to children without ADHD (Hoza et al., 2005). Social impairment is not a fleeting concern, as impairment and peer rejection in early childhood are predictive of peer rejection and social problems years later (Ollendick, Weist, Borden, & Greene, 1992), as well as future academic impairment (Malecki & Elliot, 2002). Further, social impairment contributes to an increased risk for delinquent behavior and substance use in youth with ADHD (Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997) and to employment difficulties and romantic relationship problems in adults with ADHD (Johnston, 2002). In summary, children with ADHD often exhibit impaired social functioning and this impairment places them at-risk for poor academic, social, and long-term outcomes. Given the relationship between lower EK and higher rates of peer victimization (Miller et al., 2005), it is possible that the EK deficits observed in children with ADHD contribute to the peer rejection and social impairments they often experience. Thus, a better understanding of the nature of EK in children with ADHD may offer insights into how to best address social deficits in individuals with ADHD. This is particularly important given the research suggesting that current social skills training (SST) programs for youth with ADHD are ineffective in improving social functioning (e.g., Hoza, 2007). Furthermore, a review of SSTs for ADHD called for new SSTs to be developed from theory and empirical evidence (de Boo & Prins, 2007). These results demonstrate the need for SSTs that are based on the origins of social deficits in ADHD.

As has been documented in typically-developing children, there is a link between EK and social competence in children with ADHD. Kats-Gold et al. (2007) found that risk of ADHD moderated the relationship between facial expression recognition and social skills, with an increased number of errors negatively related to social skills for boys at-risk for ADHD. Emotion recognition errors accounted for 16% of the variance in social skills and 18% of the variance in behavior problems for the at-risk group. In addition, the results indicated that, for boys at-risk for ADHD, four EK subscale scores were significantly correlated with social skills measures (*r* range: .26 to .39), whereas for boys not at-risk for ADHD only two EK subscale scores were significantly correlated with the social skills measure (*r* range: .24 to.29). Suggesting that EK is related to social skills for boys with and without risk for ADHD, but EK errors may more greatly affect social skills in boys at-risk for ADHD compared to boys not at-risk.

Pelc and colleagues (2006) also found a relationship between EK deficits and social outcomes in ADHD. In their study, children viewed photographs of facial expressions with two different intensities (high or low intensity) of four different emotions (happy, sad, angry, disgusted) and rated which emotion was observed. Results indicated that the ADHD group was less accurate than the control group in identifying both intensity levels of sadness, and the higher intensity level of anger (*d* range: -.84 to -1.33) (Pelc et al., 2006). Results also indicated that among children with ADHD a negative relationship was seen between number of self-rated interpersonal problems and emotion recognition accuracy ($r = -0.67$).

Collectively, the research suggests that children with ADHD perform worse than typical children on EK tasks and that this performance is related to their social competence. Given the positive relationship between social competence and EK in typical children and the possible contributions that EK deficits have on social impairment in children with ADHD, the literature supports EK as a critical target for research in ADHD. A better understanding of the nature of EK deficits and how they relate to social competence may assist in developing social competence interventions for children with ADHD. However, before such interventions can be developed, more research is needed to better understand the nature of EK deficits in ADHD.

PURPORTED CONTRIBUTORS TO EMOTION KNOWLEDGE DEFICITS IN CHILDREN WITH ADHD

Although EK deficits in children with ADHD are documented, the factors contributing to these deficits are unknown. Researchers have hypothesized that overall inattention or inattention to the critical aspects of emotional stimuli may contribute to emotion recognition deficits; however, only two studies have specifically examined the relationship between inattention measures and EK accuracy. Miller et al. (2011) reported a positive relationship between self-rated inattention symptoms and number of sad-affect recognition errors in adults with ADHD. The authors hypothesized that inattention problems may interfere with attending to the critical cues of social situations, thereby affecting the ability to recognize and respond to the emotions of others. However, this study was conducted with adults and used self-report measures of inattention; thus, findings should be replicated with children and with collateral informants of inattention symptoms and/or objective behavioral indicators of inattention.

In their study of EK in children with ADHD and children with an ASD, Sinzig and colleagues (2008) obtained a clinician-rated measure of inattention symptoms, as well as a measure of sustained attention (an auditory tone recognition task) and inhibition (Go/No Go task). Clinician-rated inattention was not related to the total scores for the emotion recognition task, but scores on the sustained attention task and the inhibition task were related to number correct for the emotion recognition task, (r = .61 for sustained attention task; r = .49 for inhibition task). Further, the results indicated that the groups with ADHD (ADHD only and ADHD + ASD) were less accurate in emotion recognition than the two other groups (ASD only and control). These results provide support for the

hypothesis that inattention (and possibly other symptoms of ADHD) are important contributors to decreased emotion recognition accuracy because the children with ADHD were consistently least accurate, even in comparison to children with an ASD only (who also had social impairment). A limitation of this study is that the sustained attention task was auditory in nature (i.e., sustaining attention to a 10-minute series of musical tones), whereas the EK stimuli were visual in nature (i.e., images of faces and images of eyes). Thus, EK and attention were measured across sensory domains. Measurement of inattention via the same sensory modality used when viewing and identifying emotion in images provides information on the type of inattention problems most likely to contribute to EK deficits.

Others have not directly examined the relationship between measures of inattention and EK, but have hypothesized that inattention poses a problem by interfering with perception of emotion stimuli. For example, Corbett and Glidden (2000) discussed that inattention may cause children with ADHD to miss subtle cues of emotion, therefore resulting in inaccurate or incomplete perception of emotional stimuli. Furthermore, Cadesky et al. (2000) reported that the decreased EK accuracy cannot be explained by a response bias. Their results indicated that the ADHD group and control group had the same distribution of errors among the different emotions, but the ADHD group had a greater number of errors overall; thus, children with ADHD were not repeatedly mistaking one particular emotion or over representing one emotion choice in their responses. The authors discussed that inattention may have affected the children's perception of the stimuli or affect EK accuracy through another unknown mechanism.

Additionally, the pattern of data from the Da Fonseca et al. (2009) study provides some support for the idea that inattention to the proper aspects to emotion stimuli (rather than overall inattention) is negatively affecting EK in children with ADHD. The results indicated that the ADHD group performed as well as the control group on a non-emotion object task that was identical in design to the emotion task. If overall inattention to stimuli were a problem, it should have affected both tasks, but decreased accuracy was found between groups only for the emotion task. This suggests that children may not be attending to the most relevant cues in emotion stimuli (e.g., eyes and mouths) or may be misinterpreting the emotion content of the emotion task (i.e., an information processing deficit). It may be that emotion content is more negatively affected by poor attention (i.e., cues to be detected are more subtle) or that the emotion content is more difficult to accurately decipher if such subtle cues are missed.

In relation to EK and children with ADHD, simply viewing facial expressions does not mean the child is processing the parts of the face critical to emotion recognition. Here lies the benefit of using eye-tracking technology to investigate the relationship between visual inattention and EK in children with ADHD because eye-tracking allows for recording of visual fixations on areas of an image while the child views an image. Measuring visual fixations with eye-tracking technology provides a reliable and valid tool for determining where a child is looking while viewing an image (Karatekin, 2007), and emotion recognition accuracy reveals if the information gathered from the image was used to correctly discern the displayed emotion. The use of eye-tracking and EK tasks together are important because eye-tracking alone only tells where the child looks when viewing the image, it does not offer insight into how the child uses that information.

Similarly, EK accuracy alone only reveals the result of information input; it does not offer insight into what information was taken in to determine that result. Thus together, the two offer insight into information input and output.

Eye-tracking has been used with participants across a wide range of ages (infant to adult) and with typical and atypical populations. When viewing faces, typical persons tend to look more frequently at the eyes, nose, and mouth compared to other areas of the faces such as cheeks or chins (Henderson, Williams, & Falk, 2005); however, when identifying emotion, the eye and mouth regions are most informative (Boucher & Ekman, 1975).

Though there are typical viewing patterns associated with face perception, scene perception viewing patterns are less defined, and this is likely because scenes vary more widely in content than do faces. However, results of scene perception eye-tracking studies indicate that eye fixations to a scene are nonrandom, and typical persons are more likely to look at relevant aspects of the scene (i.e., focal people or objects) compared to non-relevant aspects (e.g., background scenery) (Henderson, 2003; Henderson & Hollingworth, 1999). Additionally, fixation placement in a scene depends on a combination of factors (e.g., knowledge of scene, number of objects in the scene), and eye-tracking patterns change with task demands (e.g., search task or memorizing task) (Henderson, 2003; Henderson & Hollingworth, 1999). The eye-mind assumption underlies eye-tracking research and is the assumption that visual attention and cognitive attention are connected. There is strong empirical evidence that eye-tracking technology is a reliable and valid method for capturing cognitive processes (Karatekin, 2007), and visual and cognitive attention are likely to be coupled during tasks that require visual information to be processed and encoded and that include specific tasks goals that are communicated to the viewer (Just & Carpenter, 1976). Thus, during tasks that require

participants to identify the emotion represented in images, it is likely that visual and cognitive attention will be focused on the same areas.

Pishyareh and colleagues (2012) are among the few researchers who have used eye-tracking to examine visual patterns to emotion stimuli among children with ADHD. The authors simultaneously presented children with two scenes of differing valence (e.g. pleasant-unpleasant) and examined duration of first gaze for each scene of the pair. Results indicated that children with ADHD spent less time viewing pleasant pictures in the pleasant-unpleasant and pleasant-neutral pairings compared to controls (Pishyareh et al., 2012). These results suggest viewing preferences may differ between children with and without ADHD; however, they do not provide insight into how viewing patterns may differ *within* a scene. Thus, further research is needed to examine how within-scene viewing patterns differ between children with and without ADHD and the extent to which such patterns are related to EK and social impairment.

CURRENT STUDY

In the current study, eye-tracking technology was used in conjunction with EK tasks to examine the relationship between visual attention and EK accuracy in children with and without ADHD. The author tested three hypotheses: (a) children with ADHD will have lower EK scores than typical children when viewing emotion stimuli (i.e., images of facial expressions and images of emotional situations); (b) children with will have a lower proportion of time that they view relevant (versus irrelevant) areas of emotion stimuli, and (c) proportion of time spent viewing relevant areas will more strongly predict EK and social competence than parent and teacher ratings of inattention.

METHOD

Participants

Participants were children between the ages of 8 and 12, with an IQ estimate of 79 or greater, and normal or corrected-to-normal vision. Sample characteristics are included in Table 3. Following evidence-based assessment procedures (Pelham, Fabiano, & Massetti, 2005), and Diagnostic and Statistical Manual-Fourth Edition (DSM-IV) diagnostic criteria, diagnoses and group placements were made using information from a diagnostic interview with the parent and parent and teacher rating scales of symptoms and impairment. Symptoms were considered "present" if either rater endorsed the symptom; redundant symptoms across raters were not counted twice. Impairment was considered present if endorsed in the parent interview or if a score of 3 or higher was obtained on the parent- or teacher-rated Impairment Rating Scale (Fabiano et al., 2006). All children in the ADHD group (n = 19) met DSM-IV criteria for ADHD (any subtype), thus they exhibited impairment in two settings and 6 or more symptoms of inattention and/or hyperactivity/impulsivity. To be included in the control group (n = 26), children were free of any psychiatric disorder. Because Oppositional Defiant Disorder (ODD) is frequently comorbid with ADHD, this diagnosis was not exclusionary. However, research indicates conduct problems and aggressive behavior may affect EK and eye-tracking (Cadesky et al., 2000; Horsley, Orobio de Castro, & Van der Schoot; 2010). Given these results, ODD symptom count was explored as a possible covariate. Children who were taking stimulant medication were required to abstain from this medication for at least 12 hours before testing.

Measures

Cognitive ability

The Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II; Wechsler, 2011) is a psychometrically sound tool for estimating cognitive ability in persons age 2 to 98. Two subtests (vocabulary and matrix reasoning) were administered to yield a full-scale IQ (FSIQ) estimate. Both subscales and FSIQ scores demonstrate strong internal reliability (*r* range: .87 to .96 for children; Wechsler, 2011).

Diagnostic interview

The Children's Interview for Psychiatric Syndromes-Parent Version (P-ChIPS; Weller, Rooney, Fristad, & Weller, 1999*)* is a semi-structured diagnostic interview conducted with the parent to assess for the most common psychiatric disorders. The interview content is based on DSM-IV (American Psychiatric Association, 1994) criteria, and the interview can be completed for youth ages 6-18. Research on the P-ChIPS has shown it to be a valid measure for diagnosing psychiatric disorders in children (Weller, Weller, Fristad, Rooney, & Schecter, 2000) and to demonstrate satisfactory sensitivity in relation to clinician diagnosis (average of 87% sensitivity across disorders; Fristad, Teare, Weller, Weller, & Salmon, 1998).

ADHD and ODD symptoms

The Disruptive Behavior Disorders (DBD) Rating Scale (Pelham, Gnagy, Greenslade, & Milich, 1992) can be completed by parents and teachers to assess the presence and severity of ADHD, Conduct Disorder (CD), and ODD symptoms. The measure contains four symptom subscales: hyperactivity/impulsivity, inattention, ODD, and CD; however, the CD symptom items were not administered in the present study.

Items are rated on a 4-point scale ranging from 0 ("*not at all*" present) to 3 ("*very much*" present), with subscale scores representing the total symptom count of the subscale items. The parent and teacher versions of the DBD rating scale are psychometrically sound measurements, with good internal reliability (internal reliability range: .82 - .96; Pelham, Fabiano, & Massetti, 2005) and strong concurrent validity with other symptom rating scales (DuPaul, Power, McGoey, Ikeda & Anastopoulos, 1998; Pelham, Fabiano, & Massetti, 2005). In the current sample, internal reliability ranged from .86 - .96 for parent and teacher versions.

Impairment

The Impairment Rating Scale (IRS; Fabiano et al., 2006) can be completed by parents and teachers to assess a child's level of impairment across various domains (e.g., peer relations, academics, self-esteem). Anchors for the ratings range from 0 (*no problem/definitely does not need treatment or special services*) to 6 (*extreme problems/definitely needs treatment or special services*). Reliability and temporal stability of IRS scores are acceptable, even when two different teachers complete the measure (*r* range: .40 to .67; Fabiano et al., 2006). The IRS has acceptable convergent and discriminant validity when compared to other measures of parent and teacher rated impairment (*r* range: .58 to .85; Fabiano et al., 2006).

Social competence

The Social Skills Improvement System-Rating Scales (SSIS-RS; Gresham and Elliot, 2008) rating scales are parent and teacher report measures that assess social competence and problem behaviors. The SSIS-RS demonstrates excellent internal consistency for the parent, teacher, and student versions (α = .94 - .97 for the total scale

scores; Gresham, Elliot, Vance, & Cook, 2011). Factor analysis for the previous version (Social Skills Rating System; SSRS) revealed the same factor structure for ADHD and control groups for the teacher and parent versions, and SSRS scores have demonstrated high predictive validity (90.5% accuracy) in predicting group status (ADHD or control; Van der Oord et al., 2005). In the current sample, the internal reliability estimate was .97 for the teacher version and .92 for the parent version.

Eye-Tracking Apparatus and EK Stimuli

Eye movements were recorded via a LC Technologies EyeGaze EyeFollower binocular eye-tracking system running Interactive Minds Nyan 2.0 Data Analysis Software. The sample rate was 120 Hz and accuracy was 1 degree of visual angle. Participants were positioned 24 inches away from the display monitor, and a chin rest was used to reduce head movement. The dependent measures assessed via the eye-tracker were fixations, where a fixation was defined as maintaining a visual location for 100ms with 6 degrees of horizontal tolerance, and proportion of the total viewing time that was spent viewing areas of interests (AOIs); it represents AOI gaze duration divided by total gaze duration. These are commonly analyzed eye-tracking metrics (Duchowski, 2007) and are best-suited to test the study hypotheses because they provide information regarding viewing patterns for relevant areas.

Pictures of Facial Affect (POFA; Ekman and Friesen, 1975)

The POFA is a widely used image set of facial expressions displaying seven different emotions (happy, sad, angry, disgusted, surprised, fearful, and neutral; Ekman & Friesen, 1975). The images are black-and-white and are modeled by adult males and females (see sample in Appendix A). The POFA has been used with children with ADHD

to test emotion recognition (Singh et al., 1998). The entire set contains 110 images, each with a reliability rating from the development sample. Most studies use a subset of the total set. The images selected for use in the present study were selected to comprise a set of 6 examples of each emotion (3 males and 3 females) with a range of reliability ratings (71-100% agreement) to increase difficulty and reduce the likelihood of ceiling effects. Two neutral facial expressions were also included, which expanded the reliability range to 63-100% agreement; however, these images were not used in analyses. Facial expression EK accuracy scores are the percent of correct responses for each of the six basic emotions. AOIs for the POFA faces included the eyes and mouth of each face presented (Boucher & Ekman, 1975).

Internet Images

Though standardized images for facial expressions are available, standardized images of facial expression *in context* with discrete emotion labels are not widely available. Thus, the emotional situation images were obtained via Google Image searches using emotion-related search terms (e.g., happy child, bullying) and pilot tested prior to use (details below). Images selected included situations such as children playing at the beach or a child receiving a vaccination; each image included 1-3 faces. In the images, the face of one individual was obscured, and the child was asked to identify the emotion most likely expressed by the individual whose face was obscured, given the context (see sample in Appendix A). This method is similar to that used in Da Fonseca et al. (2009). Situation EK accuracy scores are the percent of correct responses for each of the six basic emotions. Consistent with the scene perception literature and the piloting process, the relevant areas for each image were identified prior to conducting the study. The relevant

areas were primarily focal persons and objects in the images. Any regions outside of these defined areas were considered irrelevant areas.

Pilot Testing of Internet Images

The emotion labels and relevant areas for the Internet images were obtained through a piloting process; the facial expression images were not pilot tested because the POFA images already contain emotion labels and reliability ratings and the areas relevant for emotion recognition in faces (i.e., eyes and mouth) are established in the literature on emotion detection in faces (Boucher & Ekman, 1975).

The respondents ($N = 11$) for the pilot testing were graduate students and employees at the author's institution. For each image, the respondents provided 4 responses: (a) an emotion response indicating the emotion of the individual whose face was obscured (options were angry, disgusted, fearful, happy, sad, surprised, or no emotion); (b) a rating indicating how confident they were in their emotion response (1- "*not confident at all"*, 2- "*only a little confident"*, 3- "*pretty confident"*, 4- "*very confident"*); (c) the areas of the image that provided clues/cues about the emotion of the individual whose face was covered; (d) the areas of the image that were irrelevant to determining the emotion response. The investigator reviewed all response forms and chose images that demonstrated at least 50% agreement among respondents (to prevent a ceiling). One exception is an image that obtained 5 responses for "angry", 5 responses for "sad", and 1 response for fearful; the investigator broke the tie to classify this image as "angry" because this was her original response to the image. This image was marked as potentially ambiguous and would be excluded if a similar split between "angry" and "sad" was found in the control children responses. However, 69% of control children

chose “angry”, thus the image was included in the analyses. See Table 4 for reliability and confidence ratings for each image.

Response forms were also reviewed for the relevant and irrelevant areas of each image. Relevant areas were determined by examining the qualitative responses provided for each image. Areas that were identified as relevant to discerning the emotion by at least 6 of the 11 respondents were classified as relevant areas. Each image contains 2 to 5 relevant areas that were defined as AOIs in the eye-tracking software (see Table 4 for number and description of relevant areas). Any regions outside of these relevant areas were classified as irrelevant areas.

PROCEDURE

All procedures were approved by the University Institutional Review Board. Children and their parents were recruited from a rural community via local health clinics, elementary schools, via newspaper and email advertisements, via flyers at local community locations, and from an urban community via a larger grant-funded research project. Parents interested in the study contacted research staff, at which time a phone screen was conducted to determine eligibility. If the child was taking a stimulant medication, the parents were informed that the study requires a 12-hour abstinence from stimulant medication. Parents who were in agreement with these procedures and who passed the phone screen were scheduled for a study session. Upon arrival for the study session, informed consent and assent procedures were completed. At this time the child's teacher name and school were collected and the parent was notified that the teacher would be contacted to complete study measures. The child was then escorted to a testing room containing the eye-tracking equipment to complete the WASI-II and eye-tracking task (task order was counterbalanced across participants). The parent was escorted to a different room to complete the diagnostic interview and rating scales.

For the EK and eye-tracking procedures, first, the child was told that he or she would see pictures of different people and would be asked to identify the emotion in each picture. A brief definition of each emotion option (happy, sad, mad, disgusted, surprised, scared, no emotion) and an example of the emotion in context was read to the child. The child then received brief vision, color, and ocular-motor screening; one child was excluded on the basis of failing the color screening. After passing the screenings, the child then completed the eye-tracking system's brief calibration process. Following

calibration, the first EK task was introduced, either emotion recognition in faces (henceforth referred to as the Faces task) or emotion in situations (henceforth referred to as the Situations task). The order of task administration was counterbalanced to have half of the participants in each group receive the facial expression images first and the other half receive the situation images first.

As an introduction to the Faces task, the child was told that pictures of different people will be shown and that after each picture he or she will be asked what emotion the person was displaying. As an introduction to the Situations task, the child was told that images of different scenes will be shown and that in the image the face of one person will be covered. The child was then told that he or he will be asked the emotion of the person whose face was covered. Before each subtest, the child was reminded of the seven emotion options and shown a screen displaying the options. One training trial was completed before the test trials. Images were displayed on a computer screen for 4 seconds for the Faces task and 7 seconds for the Situations task, and then replaced by a screen showing the response options. These display times were chosen because they were considered a sufficient length of time to allow the children to examine the images and were appropriate for the study hypotheses. Children had unlimited time to respond and were allowed to verbalize or point to the word to indicate their response. A total of 38 facial expression images were shown (i.e., six trials per basic emotion and two neutral). A total of 20 situation images were shown (i.e., two to four trials per basic emotion and one trial for neutral).

RESULTS

Data Preparation

The author tested for group differences for demographic variables and examined possible variables for use as covariates. Table 3 contains the demographic data for the sample. As expected, the ADHD group had higher values for all three DBD subscales of the parent and teacher DBD (ps < .004). On average, children in the control group were older ($t(43) = 2.18$, $p = .04$), had a higher TSSIS social skills standard score ($t(43) = 4.25$, $p < .001$), were less likely to be male ($t(43) = 2.37$, $p = .03$), and had fewer ODD symptoms ($t(43) = -2.77$, $p = .011$) than children in the ADHD group. Given the significant difference in age and gender between groups and their significant correlations with the outcome variables, age and gender were used as covariates. ODD count was not significantly correlated with EK outcomes, but was correlated with TSSIS, thus it was used as a covariate only in the TSSIS analyses. Parent-rated ODD was used opposed to teacher-rated ODD to reduce common-method variance in the TSSIS analyses (the correlation between parent and teacher ODD was .56). See Table 5 for correlations between demographic variables included in the analyses. No differences were found between groups for grade level, WASI composite score, PSSIS social skills standard score, race, income range, or parental education. Of note, though chi-square tests for income and race were non-significant, the mean income range and racial breakdown across the groups varies. Approximately two-thirds of the ADHD group reported an income less than $50,000, whereas only approximately a third of the control group reported an income less than $50,000. Further, over half of the control group was

Caucasian, whereas less than half the ADHD group was Caucasian. Thus, these effects may have been significant with a larger sample.

Analytic Plan

To test Hypotheses A and B, the author conducted mixed design Multivariate Analysis of Covariance (MANCOVA) analyses to compare the groups on EK accuracy and AOI proportion, controlling for age and gender; group status was the between-subjects factor and emotion types were the within-subject factors. In interpreting MANCOVA results, univariate were only interpreted if multivariate test results were significant. Additionally, due to small sample size and the potential for the analyses to be underpowered based on the a priori power analysis, effect sizes are reported and interpreted using Cohen's conventions (Cohen, 1988; i.e., small: 0.2; medium: 0.5; large: 0.8). To test Hypothesis C, the author conducted hierarchical linear regressions to determine which measure of inattention (parent DBD inattention, teacher DBD inattention, or AOI proportion) better predicted EK accuracy and social competence. Age and gender were used a covariates in the regressions models with EK accuracy; for models with social competence, ODD symptoms were added as a third covariate.

In cleaning the eye-tracking data, for trials where the child's eyes were covered/closed or the child looked away, the eye-tracking data for this trial were compared to other data for that emotion and task (e.g., other happy images in the Faces task). If the data for the suspect trial did not lie within the range of other trials for the same emotion and task, then the trial was excluded; if it was within the range it was

Hypothesis A: Children with ADHD will have lower EK accuracy scores when viewing emotion stimuli compared to control children

The first MANCOVA examined accuracy for the Faces task with group as the between-subjects independent variable, percent correct for each of the 6 basic emotions of the Faces task as within-subject factors and dependent variables, and age and gender as covariates. Neither of the covariates were significant, though age was marginally significant ($F(5, 37) = 2.04$, $p = .10$). The multivariate test results revealed a significant main effect for Emotion Type ($F(5,37 = 3.85$, $p = .007$), but there was no significant main effect for Group ($F(1,41) = 0.06$, $p = .81$) or significant Group x Emotion Type interaction ($F(5,37) = 0.33$, $p = .90$). Simple effects test for the Emotion Type, indicated that children (collapsed across groups), were more accurate when the face displayed happy, mad, and surprised emotions, than when the face displayed disgusted, sad, or scared emotions. With regard to group differences, small effect sizes were observed (d range: -.39 to .18; see Table 6), suggesting that for certain emotions, children with ADHD were less accurate than children without ADHD in recognizing emotion in facial expressions. The largest group difference was found for faces displaying a disgusted emotion ($d = -0.39$).

The second MANCOVA examined accuracy for the Situations task with the same independent variable and covariates as the first MANCOVA, and the 6 percent correct scores, one for each emotion, from the Situations task as the within-subject factors and dependent variables. Neither of the covariates were significant, though gender was marginally significant ($F(5, 37) = 2.06$, $p = .09$). The multivariate test results revealed no significant main or interactions effects (Emotion Type main effect ($F(5,37 = 1.52$, $p =$

.21); Froup main effect (F(1,41) = 0.04, p = .83; Group x Emotion type interaction (F(5,37) = 0.47, p = .80). With regard to group differences, small effect sizes were observed (d range: -0.46 to 0.00; see Table 6). The largest group difference was found for situations representing happy (d = -.46). Results across the tasks suggest that, for some emotions, children with ADHD are less accurate than those without ADHD in recognizing emotion in facial expressions and situations.

Hypothesis B: Children with ADHD will have a lower proportion of time that they view relevant areas of emotion stimuli compared to control children

The first MANCOVA examined the between groups difference in proportion of total viewing time spent viewing the areas of interest (AOI; i.e., eyes and mouth) for the facial expression images. Average AOI proportion was summed across images for each emotion, resulting in 6 sums of the average AOI proportion, one value for each emotion; these served as the within-subject factors and dependent variables. Group was the between-subjects independent variable, and age and gender were covariates. Neither covariate was significant (p's > .17). The multivariate test results revealed no significant main or interactions effects (Emotion Type main effect (F(5,37 =0.95, p = .46); Group main effect (F(1,41) = 0.00, p = .99; Group x Emotion Type interaction (F(5,37) = 0.63, p = .38). With regard to group differences, small effect sizes were observed (d range: -0.42 to 0.00). The largest effect size (d = -0.42) was observed for happy faces. The effect sizes suggest that children with ADHD spent less time than children without ADHD viewing the relevant areas (i.e., eyes, mouth) of faces for certain emotions (see Table 6).

The second MANCOVA examined average AOI proportion for the Situations task. The independent variable and covariates were the same as the first MANCOVA of

this hypothesis, and AOI proportion averages for each emotion on the Situations task were the dependent variables. Neither covariate was significant (*p's* > .43). The multivariate test results revealed no significant main or interactions effects (Emotion Type main effect (F(5,37 =0.1.43, p = .24); Group main effect (F(1,41) = 0.97, p = .33; Group x Emotion Type interaction (F(5,37) = 0.1.17, p = .34). However, with regard to group differences, small to medium effect sizes were observed (*d* range: -0.73 to 0.35; see Table 6), indicating that children with ADHD spent less time viewing the relevant areas of the images compared to children without ADHD. The largest effect size was observed for situations representing Mad (*d* = -0.73).

Hypothesis C: Proportion of time spent viewing relevant areas will be a stronger predictor of EK and social competence than parent and teacher ratings of inattention

Three hierarchical linear regressions were conducted to test this hypothesis. In the first model, total Faces percent correct (across all emotions) was the criterion variable, age, and gender, were entered in block 1; parent DBD inattention symptom count, teacher DBD inattention symptom count, and the average AOI proportion across all emotions for the Faces task were entered in the block 2. The first block containing the covariates was significant (R^2 = .24, p = .003). Age (β = .33, p = .02) and gender (β = .36, p = .01) were related to accuracy, indicating that being older and a female was associated with greater facial expression EK accuracy. The second block of predictors accounted for an additional 13% of the variance, which was marginally significant (p = .06). Of block 2, AOI proportion (β = .26, p = .07) and teacher-rated inattention β = .27, p = .09) were marginally significant. See Table 7 for regression results.

The second hierarchical linear regression conducted was identical to the first, except that the percent correct for the Situations task was used as the criterion variable and average AOI proportion across all emotions for the Situations task was the third predictor entered as part of the second block. The first block of the model was significant ($R^2 = .18$, $p = .02$), with age related to situational EK accuracy ($\beta = .40$, $p = .01$). When the second block was added, none of the variables (parent rating of inattention, teacher ratings of inattention, total AOI gaze duration) were predictive of percent correct for the Situations task.

The third hierarchical linear regression conducted was similar to the two preceding regressions with the exception that teacher SSIS social skills standard score was used as the criterion variable, parent ODD symptoms count was added in block 1, and average AOI proportion summed across both subtests served as the third predictor entered as part block 2. Block 1 of the model was significant ($R^2 = .38$, $p > .001$). All three covariates were related to teacher SSIS score (β range: -0.33 to 0.33, p's $< .04$). Being older, being female, and having fewer ODD symptoms were associated with higher teacher-rated social competence. For the final model, teacher DBD inattention symptom count ($\beta = -0.61$, $p < .001$) and parent DBD ODD symptom count ($\beta = -0.27$, $p = .027$) were significantly predictive of teacher-rated social competence. Thus, teacher and parent ratings of behavior were more predictive of social competence than time spent viewing relevant areas of the images.

DISCUSSION

Previous studies provide evidence that children with ADHD exhibit deficits in facial expression recognition for one or more emotions. However, inconsistent findings across studies and limitations within these studies indicated that additional research is needed to shed greater light on this possible deficit. Further, despite the hypothesized role of visual attention in this deficit, no studies have examined how visual attention relates to EK accuracy and social competence in individuals with ADHD. In the current study, limitations of previous studies were addressed and eye-tracking technology was used to examine the relationship between visual attention and EK and social competence among children with and children without ADHD. Effect sizes suggest that for some emotions (e.g., disgusted, surprised) children with ADHD are less accurate than children without ADHD in recognizing emotion in faces with and without context and that they spend less time viewing the relevant areas of these images. However, viewing patterns were not significantly related to emotion recognition accuracy, though gender and age were related to accuracy. These results are discussed in relation to the existing literature and to future directions for social and emotional research in children with ADHD.

The MANCOVAs assessing EK accuracy in children with and without ADHD did not reveal significant group differences for either emotion recognition task, though small effect sizes were observed. The patterns reveal several noteworthy findings. First, the effect sizes suggest that children with ADHD are less accurate than children without ADHD in recognizing certain simple and complex emotions. The largest effect sizes of the Faces task were for disgusted and surprised, which are potentially more complex or nuanced emotions than happy, mad, and sad. Age was correlated with disgusted accuracy

(r = .37, p = .01) and marginally significant for surprised accuracy (r = .27, p = .08). Given that age was a significant predictor of EK accuracy, the group differences for these more complex emotions may explain why children with ADHD are often considered emotionally less mature than same-aged peers (Barkley, 2006). Perhaps they have not mastered the detection or interpretation of more nuanced emotional cues to the same degree as their typically-developing peers. The largest effect sizes for the Situation task were disgusted and happy, which suggests that identification of both negative and positive valence emotions and both simple and complex emotions pose difficulties for children with ADHD. Age was correlated with Situations happy accuracy (r = .43, p = .003), but was not correlated with disgusted accuracy (p = .81). Interestingly, the disgusted and happy situation images received 100% reliability and high confidence rating in pilot testing (see Table 4); thus group differences were observed for the relatively "easier" images that had clear cues. Taken together, the results suggest that when identifying emotion in faces, complex emotions pose more difficulty than simple emotions, and when identifying emotion in a situation, factors beyond emotion complexity contribute to accuracy in recognizing the emotion represented.

Second, the non-significant results were surprising given that in previous studies (see Table 1) individuals with ADHD were less accurate than individuals without ADHD in recognizing the emotion represented for at least one or more images and large effect sizes were reported. The differences may be attributed to differences in number of children with ADHD in the sample (n = 14 to 86 in cited studies vs. n= 19 in the current study) or average age (8 to 13.6 in cited child studies vs. 9.5 in the current study). Though the current study is in the range of these sample size and age values, the majority

of cited studies had more and older average age of participants. Additionally, the POFA images used in previous studies had a higher reliability rating (>.80) than the images in the current set. The current study included POFA images with a range of 71-100% reliability; this expanded range was used to reduce the chance of a ceiling effect, as was seen in previous studies. While it would be difficult to entirely remove ceiling effects because most children can recognize simple emotions in faces, ceiling effects were observed in only a few of the emotions tested, and the average EK accuracy score, collapsed across emotion, ranged from 70% - 81% across the tasks and groups, suggesting that overall ceiling effects were minimized. Further, it is noteworthy that the larger effect sizes for each EK accuracy task were found for the total score (across all emotions). Of the cited studies, the largest effect size came from Cadesky et al. (2000), who collapsed across all emotions in analyses. Studies that summed across all emotions tended to have larger effect sizes than those that reported separate emotion scores, though large effect sizes were reported in studies that reported individual emotions only. Had previous authors reported both separate emotion results and overall emotion results, a pattern of mixed magnitude effect sizes across emotions similar to that found in the current study may have been observed. In sum, non-replication of statistically significant group differences may be attributed to current study's small sample size, and smaller effect sizes compared to previous studies may be due to using more difficult images, having an overall younger age of participants, or examining EK accuracy in each emotional separately. Nonetheless, the current findings provide some evidence that children with ADHD struggle with EK accuracy with complex emotions in faces with and without context.

Beyond examining EK accuracy, the current study extended results of previous studies by combining eye-tracking with EK tasks to investigate viewing patterns while children viewed the images. Analyses that compared the proportion of time spent viewing relevant areas of the images between groups were not significant. However, effect sizes were small to medium, suggesting that children with ADHD spend a lower proportion of time viewing the areas of an image that are relevant to discerning the emotion represented. For the EK tasks, children were specifically asked to identify emotion in the images, thus it may be that when given that explicit task, viewing patterns of children with ADHD to the AOIs are more similar to those of children without ADHD. Eye-tracking variables (e.g., velocity or direction of gaze) and stimuli (e.g., dots, paired images) used in other studies with children with ADHD differ from the current study, thus making a direct comparison is difficult; however, the current findings align with previous research that indicates viewing patterns differ between those with and without ADHD (e.g., Pishyareh et al., 2012). It is important to note that in daily social interactions children are not explicitly focused on identifying emotion in others or assessing emotion in a situation; thus viewing patterns may differ based on if the task demands were different (e.g., free-viewing of the stimuli). Indeed a recent study that reviewed eye-tracking studies with children with ASD literature (Guillon, Hadjikhani, Baduel, & Roge; 2014) explicitly included studies examining spontaneous visual attention to social stimuli and explicitly excluded emotion recognition studies because eye-tracking patterns vary across these tasks. Given that viewing patterns can differ based on task demand, additional research that examines visual attention during tasks that relate to real-life demands (e.g., recognizing emotion in a conversation) may provide insight

into the type of inattention likely to impact social interactions in individuals with ADHD. Interestingly, the largest AOI proportion effect size for the Situations task was for mad situations. The disruptive behavior of children with ADHD often elicits negative or angry behavior from adults, thus the finding that children with ADHD spend less time than typical children viewing relevant areas in angry situations may translate to their real-time interactions with others who are angry, such as missing the important contextual cues that indicate someone is angry.

The hypothesis that total time spent viewing relevant areas will better predict EK and social competence was not confirmed. None of the examined measures of inattention/attention were predictive of EK accuracy, and teacher-rated inattention was the strongest predictor of teacher-rated social competence. Thus neither trait level of inattention, as rated by parent and teacher, nor state level of attention as indexed by visual attention were predictive of EK accuracy in this sample. Of the covariates, age predicted both Faces and Situation task accuracy, in that being older was associated with greater accuracy. A better understanding of factors besides age that are associated with greater situational emotion knowledge is needed to identify potential skills to build in children with ADHD.

Finally, teacher ratings of inattention and parent ratings of ODD symptoms more strongly predicted teacher-rated social competence than viewing time and parent ratings of inattention. Thus, it may be that observed child behavior is a stronger predictor of social competence than visual attention while viewing images. However, this finding may also be a function of common-method variance. Certain SSIS items are possibly more related to eye-tracking patterns than other items (e.g., Makes eye contact when talking vs.

Speaks in appropriate tone of voice), thus future analyses with a subset of SSIS items may reveal which aspects of social competence are and are not related to eye-tracking patterns.

The availability of eye-tracking data allowed for further investigation into EK in children with ADHD, thus the author conducted exploratory secondary analyses. Though proportion of time spent viewing relevant areas did not significantly differ, the number of fixations to those areas may differ. For example, children with ADHD may shift their gaze more frequently within those areas, resulting in a greater number of fixations compared to children without ADHD. To investigate whether children with ADHD shift their gaze more frequently than children without ADHD, total AOI fixations counts for each emotion were examined. The results were similar to those for Hypothesis B. Specifically, non-significant multivariate effects and small to medium effect sizes (*d* range: -0.68 to 0.17) were observed across the tasks and emotions. Comparing the pattern of fixation count effect sizes to accuracy effect sizes revealed mixed findings. For example, for disgusted faces, the accuracy effect size was -0.39 and the AOI fixation count effect size was -0.33, suggesting that decreased fixations and decreased accuracy effects were observed in children with ADHD. However for happy situations, the accuracy effect size was -0.46 and the AOI fixation count effect size was 0.00, suggesting a decreased accuracy in children with ADHD, but the same number of fixations to relevant areas compared to children without ADHD. Thus, the same information may have been viewed, but it was interpreted differently to yield a different answer. To the author's knowledge, there are no other studies that examined viewing patterns during emotion recognition tasks in children with ADHD. Thus, additional research is needed to

further investigate visual attention and EK in children with ADHD and to further explore variables that contribute to EK accuracy differences between children with and without ADHD because visual attention alone cannot explain the differences.

Additional post-hoc analyses indicate that response times were significantly different between groups. Thus, although children with ADHD were not significantly less accurate, it took them longer to process the emotion cues and respond to the task. This may imply that children with ADHD are using more cognitive resources or taking longer to process the information to arrive a similar result compared children without ADHD. The additional time to respond may affect the real-time dynamics of social interactions, and if the longer response time is indicative of a longer processing time or greater cognitive load, it may affect the ability for the child to generate and execute social behaviors. The present data are not appropriate for drawing conclusions related to cognitive resources, but response times were negatively correlated with EK accuracy (Situations response time and accuracy, r = -.36) and social competence (Faces response time and teacher SSIS, r = -.46); thus, there is likely a relationship between these variables that is worth exploring in future research. The large response time effect sizes were observed for scared situations (d = 0.83) and surprised faces (d = .90), whereas the accuracy effect sizes for these emotions were small, thus reinforcing the point that there is a discrepancy between the amount of effort children with ADHD must exert, compared to children without ADHD, to correctly recognize emotions.

Limitations and Future Directions

There are limitations of the current study. First, due to recruitment difficulties, the sample size is smaller than required for the analyses. Thus, the analyses are

underpowered. Reporting and interpreting effect sizes provides information on the nature of the relationships examined, however a larger sample would allow for greater confidence in the findings. Second, a limitation of all eye-tracking studies is the assumption that visual fixations represent where the brain is focusing visual attention. This eye-mind assumption underlies all eye-tracking research. However, design of the study in terms of stimuli, task goal, and instructions provided to the children helped to support the connection between visual and cognitive attention. Further, the use of eye-tracking patterns as the input and EK accuracy as the output together help demonstrate how gaze duration and visual fixations are related to obtaining information relevant to a task and whether the information obtained was used or interpreted properly. Third, the children in the ADHD group represent those with moderate (rather than severe) symptom severity and impairment. With a more symptomatic or more socially impaired ADHD group larger group differences may be found. Fourth, children in the control group were more likely than children in the ADHD group to be female and older, which may have affected the group differences because these demographic factors were associated with greater EK and visual attention. Thus, it is important for future samples to match groups on age and gender to better control for these factors.

Combining eye-tracking technology with EK and social research in children with ADHD offers the potential to investigate how inattention may affect EK and social functioning in children with ADHD. The current study examined all AOIs (e.g., eyes, mouth) together, with total all AOI proportion used in the analyses. Future analyses to determine whether viewing times differ *between* the relevant areas could offer further insight into how viewing patterns differ between those with and without ADHD. For

example, children with ADHD may view the mouth more often than the eyes when viewing faces and this viewing pattern may have implications for accurately recognizing certain emotions. Additionally, children with ADHD may experience emotion recognition as more cognitively taxing than children without ADHD and this has important implications for the quality of their social interactions. Thus, the use of eye-tracking variables that are more closely related to cognitive processing (e.g., pupil dilation) may allow for more direct testing of this hypothesis. Finally, advances in eye-tracking technology allow for a variety of systems, such as head-mounted or systems similar to glasses. Use of eye-tracking systems that can be used during situations with greater ecological validity than the current study (e.g., reacting to real-time stimuli, interacting socially) could offer further examination of social deficits in children with ADHD.

Summary

Recognizing emotion in others and using the context of a situation to infer the emotion of others are EK skills that are important to social functioning and that may be deficient in children with ADHD. Given the social impairment children with ADHD often experience, investigating factors that contribute to this impairment and methods for reducing the impairment is needed to inform effective treatment for social and emotional impairment in children with ADHD. Further, EK is positively associated with emotion regulation and positive peer interactions, two areas where children with ADHD often have difficulties. Effect sizes for the current study indicate that there are group differences in EK accuracy and viewing patterns to EK stimuli for certain emotions between children with and without ADHD. The use of eye-tracking technology is an

extension to previous studies and helps shed light on the information input when children with ADHD view emotion- and social- related stimuli. These data begin research on the role of visual attention in EK and social functioning in children with ADHD, investigating further a potential contributor to EK deficits in individuals with ADHD. Future research that allows for more detailed analysis of viewing patterns and includes proxies for cognitive processing during EK tasks can begin to disentangle the complex role of EK in social functioning.

REFERENCES

Abikoff, H., Hechtman, L., Klein, R. G., Gallagher, R., Fleiss, K., Etcovitch, J.,… & Pollack, S. (2004). Social functioning in children with ADHD treated with long-term methylphenidate and multimodal psychosocial treatment. *Journal of the American Academy of Child & Adolescent Psychiatry*, 43(7), 820-829.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th Edition). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (Revised 4th ed.). Washington, DC: Author.

Barkley, R. (2006) *Attention-Deficit Hyperactivity Disorder: A Handbook for Diagnosis and Treatment.* 3. Ed. New York: Guilford Press.

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.

Boucher, J. D., & Ekman, P. (1975). Facial areas and emotional information. *Journal of Communication*, 25(2), 21-29.

Cadesky, E., Mota, V., & Schachar, R. (2000). Beyond words: How do problem children with ADHD and/or conduct problems process nonverbal information about affect? *Journal of the American Academy of Child & Adolescent Psychiatry*, 39(9), 1160-1167.

Casey, R. J. (1996). Emotional Competence in children with externalizing and internalizing disorders. In Lewis, M & Sullivan, M.W. (Eds.), *Emotional*

development in atypical children (pp. 161-183). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences (2nd Edition)*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Corbett, B., & Glidden, H. (2000). Processing affective stimuli in children with attention-deficit hyperactivity disorder. *Child Neuropsychology*,*6*(2), 144-155.

Curtis, C., & Norgate, R. (2007). An Evaluation of the Promoting Alternative Thinking Strategies Curriculum at Key Stage 1. *Educational Psychology In Practice*, 23(1), 33-44.

Da Fonseca, D., Seguier, V., Santos, A., Poinso, F., & Deruelle, C. (2009). Emotion understanding in children with ADHD. *Child Psychiatry and Human Development*, *40*(1), 111-121.

de Boo,G. & Prins, P. (2007). Social incompetence in children with ADHD: Possible moderators and mediators in social-skills training. *Clinical Psychology Review*, 27(1), 78-97.

Denham, S. (1998). *Emotional development in young children*. New York: Guilford Press.

Denham, S., Blair, K. A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S., & Queenan, P. (2003). Preschool emotional competence: Pathway to social competence. *Child Development*, 74(1), 238-256.

Duchowski, A. (2007). *Eye Tracking Methodology Theory and Practice.* 2 Ed. London: Springer.

DuPaul, G., Power, T., McGoey, K., Ikeda, M., & Anastopoulos, A. (1998). Reliability and validity of parent and teacher ratings of attention-deficit/hyperactivity disorder symptoms. Journal of Psychoeducational Assessment, 16, 55–68.

Ekman, P., & Friesen, W. V. (1975). *Pictures of facial affect*. Palo Alto, CA: Consulting Psychologists Press.

Fabiano, G., Pelham, W., Waschbusch, D., Gnagy, E., Lahey, B., Chronis, A.,… & Burrows-MacLean, L. (2006). A Practical Measure of Impairment: Psychometric Properties of the Impairment Rating Scale in Samples of Children With Attention Deficit Hyperactivity Disorder and Two School-Based Samples. *Journal of Clinical Child and Adolescent Psychology*, 35(3), 369-385.

Fristad, M., Teare, M., Weller, E., Weller, R., & Salmon, P. (1998). Study III: Development and concurrent validity of the Children's Interview for Psychiatric Syndromes (P-ChIPS). *Journal of Child and Adolescent Psychopharmacology,* 8(4), 221-226.

Greene, R., Biederman, J., Faraone, S., Sienna, M., & Garcia-Jetton, J. (1997). Adolescent outcome of boys with attention-deficit/hyperactivity disorder and social disability: Results from a 4-year longitudinal follow-up study. *Journal of Consulting and Clinical Psychology*, 65(5), 758-767.

Gresham, F., & Elliot, S. (2008). *Social skills improvement system: Rating scales*. Bloomington, MN: Pearson Assessments.

Gresham, F., Elliott, S., Vance, M., & Cook, C. (2011). Comparability of the Social Skills Rating System to the Social Skills Improvement System: Content and

psychometric comparisons across elementary and secondary age levels. *School Psychology Quarterly*, 26(1), 27-44.

Guillon, Q., Hadjikhani, N., Baduel, S., & Rogé, B. (2014). Visual social attention in autism spectrum disorder: Insights from eye tracking studies. *Neuroscience & Biobehavioral Reviews*, *42*, 279-297.

Henderson, J. (2003). Human gaze control during scene perception. *TRENDS in Cognitive Sciences*, 7(11), 498-504.

Henderson, J., & Hollingworth, A. (1999). High-Level Scene Perception. *Annual Reviews of Psychology,* 50, 243-271.

Henderson, J., Williams, C., & Falk, R. (2005). Eye movements are functional during face learning. *Memory & Cognition (Pre-2011)*, 33(1), 98-106.

Hoza, B. (2007). Peer functioning in children with ADHD. *Journal of Pediatric Psychology*, 32(6), 655-663.

Hoza, B., Mrug, S., Gerdes, A., Hinshaw, S., Bukowski, W., Gold, J. A.,… & Arnold, L. E. (2005). What Aspects of Peer Relationships Are Impaired in Children With Attention-Deficit/Hyperactivity Disorder? *Journal of Consulting and Clinical Psychology*, 73(3), 411-423.

Horsley, T., Orobio de Castro, B., & Van der Schoot, M. (2010). In the eye of the beholder: eye-tracking assessment of social information processing in aggressive behavior. *Journal of Abnormal Child Psychology*, 38, 587-599.

Izard, C., Fine, S., Schultz, D., Mostow, A., Ackerman, B., & Youngstrom, E. (2001). Emotion Knowledge as a Predictor of Social Behavior and Academic Competence in Children At-Risk. *Psychological Science,* 12(1), 18-23.

Izard, C., King, K., Trentacosta, C., Morgan, J., Laurenceau, J., Krauthamer-Ewing, E., & Finlon, K. (2008). Accelerating the development of emotion competence in Head Start children: Effects on adaptive and maladaptive behavior. *Development and Psychopathology*, *20*(1), 369-397.

Johnston, C. (2002). The impact of attention deficit hyperactivity disorder on social and vocational functioning in adults. In Jensen, P, Cooper, J.R. (Eds), *Attention deficit hyperactivity disorder: State of the science-best practices* (pp. 601-621). Kingston, NJ: Civic Research Institute.

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: An official publication of the International Society for Research in Child and Adolescent Psychopathology*, *35*(3), 363-378.

Kats-Gold, I. & Priel, B. (2009). Emotion, understanding, and social skills among boys at risk of attention deficit hyperactivity disorder. *Psychology in the Schools*, *46*(7), 658-678.

Kusche, C., Greenberg, M., & Beilke, B. (1988). *The Kusche affective interview.* Unpublished manuscript, University of Washington, Department of Psychology, Seattle, WA.

Malecki, C., & Elliot, S. (2002). Children's social behaviors as predictors of academic achievement: A longitudinal analysis. *School Psychology Quarterly*, 17(1), 1-23.

Miller, A., Gouley, K., Seifer, R., Zakriski, A., Eguia, M., & Vergnani, M. (2005). Emotion knowledge skills in low-income elementary school children:

Associations with social status and peer experiences. *Social Development*, *14*(4), 637-651.

Miller, M, Hanford, R. B., Fassbender, C., Duke, M., & Schweitzer, J. B. (2011). Affect Recognition in Adults with ADHD. *Journal of Attention Disorders,* 15(6), 452-460.

Norvilitis, J., Casey, R., Brooklier, K., & Bonello, P. (2000). Emotion appraisal in children with attention-deficit/hyperactivity disorder and their parents. *Journal of Attention Disorders*, *4*(1), 15-26.

Nowicki, S., & Duke, M. (1994). Individual differences in the nonverbal communication of affect: The Diagnostic Analysis of Nonverbal Accuracy Scale. *Journal of Nonverbal Behavior*, 18(1), 9-35.

Ollendick, T., Weist, M., Borden, M., & Greene, R. (1992). Sociometric status and academic, behavioral, and psychological adjustment: a five-year longitudinal study. *Journal of Consulting and Clinical Psychology*, 60, 80-87.

Pelc. K., Kornreich, C., Foisy, M., & Dan, B. (2006). Recognition of Emotional Facial Expressions in Attention-Deficit Hyperactivity Disorder. *Pediatric Neurology*, 35, 93-97.

Pelham, W., & Bender, M. (1982). Peer relationships in hyperactive children: Description and treatment. In Gadow, K., Bialer, I. (Eds), *Advances in Learning & Behavioral Disabilities.* Greenwich, CT: JAI Press.

Pelham, W., Fabiano, G., & Massetti, G. (2005). Evidence-Based Assessment of Attention Deficit Hyperactivity Disorder in Children and Adolescents. *Journal of Clinical Child and Adolescent Psychology,* 34(3), 449, 476.

Pelham, W., Gnagy, E., Greenslade, K., & Milich, R. (1992). Teacher ratings of DSM-III—R symptoms for the disruptive behavior disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *31*(2), 210-218.

Pierce, K., Conant, D., Hazin, R., Stoner, R., & Desmond, J. (2011). Preference for geometric patterns early in life as a risk factor for autism. *Archives of General Psychiatry*, *68*(1), 101-109.

Pishyareh, E., Tehrani-Doost, M., Mahmoodi-Gharaie, J., Khorrami, A., Joudi, M., & Ahmadi, M. (2012). Attentional Bias towards Emotional Scenes in Boys with Attention Deficit Hyperactivity Disorder. *Iranian journal of psychiatry*, *7*(2), 93.

Rapport, L., Friedman, S., Tzelepis, A., & Van Voorhis, A. (2002). Experienced emotion and affect recognition in adult attention-deficit hyperactivity disorder. *Neuropsychology*, *16*(1), 102-110.

Saarni, C. (1999). *The Development of Emotional Competence*. New York, NY: Guilford Press.

Shapiro, E., Hughes, S., August, G., & Bloomquist, M. (1993). Processing of emotional information in children with attention-deficit hyperactivity disorder. *Developmental Neuropsychology*, 9(3-4), 207-224.

Singh, S., Ellis, C., Winton, A., Singh, N., Leung, J., & Oswald, D. (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.

Van der Oord, S., Van der Meulen, E., Prins, P., Oosterlaan, J., Buitelaar, J., & Emmelkamp, P. M. G. (2005). A psychometric evaluation of the social skills rating system in children with attention deficit hyperactivity disorder. *Behaviour Research and Therapy*, 43(6), 733-746.

Wechsler, D. (2011). *Wechsler Abbreviated Scale of Intelligence - Second Edition* (WASI-II). San Antonio, TX: Pearson.

Weller, R., Rooney, M., Fristad, M., & Weller, E. (1999). *Children's Interview for Psychiatric Syndromes: Parent Version.* Washington D.C.: American Psychiatric Press, Inc.

Weller, E., Weller, R., Fristad, M., Rooney, M., & Schecter, J. (2000). Children's Interview for Psychiatric Syndromes (ChIPS). *Journal of the American Academy of Child & Adolescent Psychiatry*, 39(1), 76-84.

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.

Table 1
Summary of Studies Examining Emotion Recognition in Children With ADHD

Study (N)	Stimuli Used	Emotions Tested	Number of trials per emotion	Response Format	Emotions with significant group differences	Emotions with non-significant group differences	Presence of ceiling effect
Boakes et al., 2008 (N = 48)	Images and video clips from television shows	Basic 6[a]	12	Free-response	Fearful, disgusted (*d*s = -0.64 to -0.73)	Happy, sad, angry; surprised marginally significant (p = .11)	Happy, sad, angry
Cadesky et al., 2000 (N = 140)	DANVA	4 (happy, sad, angry, fearful)	6 adult, 6 child	Not explicitly stated	Sad (d = -0.69)	Angry; happy and fearful marginally significant ($p <$ .06)	None for ADHD group comparisons; all four emotions for ADHD/CP group comparisons
Casey (1996), study 4 (N = 108)	Author-developed drawings	5 emotions (happy, surprised, angry, fearful, sad)	1	Oral free response and forced choice from subset of options	Not available from reported data	Not available from reported data	NR
Corbett & Glidden, 2000 (N = 74)	POFA	Basic 6, plus neutral	3	Choose from a printed sheet with the 7 options listed	Total score was collapsed across emotions. Main effect *d*s = -0.78 to -1.58	N/A	NR

Table 1 continued

Study	Stimuli Used	Emotions Tested	Number of trials per emotion	Response Format	Emotions with significant group differences	Emotions with non-Significant group differences	Presence of Ceiling Effect
Da Fonseca et al., 2009 (N = 54)	Images from French media	4 (happy, sad, angry, fearful)	10	Press a button to select 1 of 3 emoticons	No group x emotion interaction; main effect for group was significant (*d* = 0.88)	Happy, sad, angry, fearful	NR
Kats-Gold et al., 2007 (N = 111)	POFA	4 (happy, sad, angry, fearful)	8	Press a button to select 1 of 4 text options	Mistaking scared and sad for other options	Happy	Potentially for happy
Miller et al., 2011 (N = 51)	DANVA	4 (happy, sad, angry, fearful)	6	Not explicitly stated	Fearful (*d*s = 0.37 to 0.93)	Happy, sad, angry	NR
Norvilitis et al. (2000) (N =88)	Author-developed pictures	5 (happy, angry, sad, scared, surprised)	1	Free-response	Not available from reported data	Not available from reported data	NR
Pelc et al., 2006 (N = 60)	Images from Hess and Blair (1995)	4 (happy, sad, angry, disgusted); two intensities (30% and 70%)	4	Rate of emotion intensity on 7-point scale	Angry, sad (*d*s = -0.98 to -1.03)	Happy, disgusted	NR

Table 1 continued

Study	Stimuli Used	Emotions Tested	Number of trials per emotion	Response Format	Significant group differences in EK	Non-Significant emotion accuracy between group differences	Presence of Ceiling Effect
Rapport et al., 2002 (N = 56)	DANVA and POFA	4 (DANVA: happy, sad, angry, fearful); basic 6 (POFA)	6 for each stimuli set	Forced text choice of all emotion options	Happy, angry, fearful (*d*s = -0.46 to -0.90)	Sad, disgusted, neutral	Authors state there were no ceiling effects
Shapiro et al., 1993 (N = 105)	MNTAP	4 (happy, sad, angry, fearful); however, it varied across the 13 subtests	Varied across the subtests	Varied across the subtests	N/A because total score was collapsed across emotions	-	Little improvement after 8 years of age
Sinzig et al., 2008 (N = 99)	FEFA	Basic 6 plus neutral	4 to 9	Push when they knew the answer, however the exact response format is unclear	Happy, surprised (*d*s = -0.69 to -0.88)	Fearful, angry, sad, disgusted, neutral	NR

Note: MNTAP = Minnesota Tests of Affective Processing, DANVA=Diagnostic Analysis of Nonverbal Accuracy, POFA=Pictures of Facial Affect, FEFA= Frankfurt Test and Training of Social Affect, NR= not reported and/or uncertain from reported data

[a]Basic 6 emotions: happy, sad, angry, surprised, disgusted, and fearful

Table 2

Studies Examining Situational Emotion Knowledge in Children with ADHD

Study (N)	Stimuli Used	Emotions Tested	Number of trials per emotion	Response Format	Significant emotion accuracy between group differences	Non-significant emotion accuracy between group differences	Presence of ceiling effect
Da Fonseca et al. (2009)	Images from French media	4 (happy, sad, angry, fearful)	10	Press a button to indicate which of 3 emoticon options is the response	No emotion specific results reported; Only group main effect reported with ADHD group less accurate (d = 0.91)	N/A	NR
Kats-Gold & Priel (2009) (N = 152)	KAI-R	None explicitly tested in SEK portion of interview	N/A	Answers to emotion-related interview questions	N/A	N/A	N/A
Yuill & Lyon (2007) (Part 1: N = 38; Part 2: N = 30)	Author-Developed, stories and photos of emotion facial expression	Basic 6[a]	1	Match emotion photo to the story	Significance for individual emotions not reported; Main effect reported with ADHD group less accurate (ds = -0.89 to -1.98	N/A	NR

Note: KAI-R = Kusche Affective Interview-Revise; NR= not reported and/or uncertain from reported data

[a]basic 6 emotions: happy, sad, angry, surprised, disgusted, and fearful

Table 3

Sample Characteristics

	ADHD (n = 19)	Control (n = 26)
[a]Age	9.16 (0.90)	9.77 (0.95)
[a]Percent Male	78.9%	46.2%
WASI Composite Score	104 (14)	106 (16)
[a]Has taken medication for ADHD	26.3%	0%
Race		
Caucasian	47.4%	76.9%
African American	21.1%	3.8%
Other	31.6%	19.2%
Maternal Education		
Partial HS or HS Diploma	10.5%	11.5%
Partial College	26.3%	0%
Associate's Degree	10.5%	19.2%
Bachelor's Degree	31.6%	30.8%
Master's/Doctoral Degree	21.1%	38.5%
Paternal Education*		
Less than 9th Grade	5.3%	0%
Partial HS or HS Diploma	31.6%	19.2%
Partial College	0%	7.7%
Associate's Degree	5.3%	3.8%
Bachelor's Degree	5.3%	19.2%
Master's/Doctoral Degree	36.8%	50%
Mean Income Range	$25,000 - $49,999	$50,000 - $74,999
Public Assistance in Past Year	47.4%	19.2%
[a]Parent DBD Inattention Count	4.90 (2.35)	1.50 (2.47)
[a]Parent DBD Hyp/Imp Count	3.68 (2.38)	1.23 (1.37)
[a]Parent DBD ODD Count	1.90 (2.16)	0.42 (0.99)
PSSIS Social Skills Standard Score	92.89 (12.66)	99.46 (12.01)
[a]Teacher DBD Inattention Count	5.00 (2.71)	1.19 (2.53)
[a]Teacher DBD Hyp/Imp Count	4.16 (3.30)	0.27 (0.67)
[a]Teacher DBD ODD Count	2.79 (3.22)	0.35 (0.89)
[a]TSSIS Social Skills Standard Score	84.74 (12.82)	103.73 (16.10)

*Values do not add up to 100% due to missing data.

[a]Denotes significant group differences ($p < .05$) according to t-tests or chi-square tests.

Table 4

Stimuli Images Descriptions

Image Content	Emotion	Relevant Areas	No. of Relevant Areas	Reliability Rating	Average Confidence Rating[a]
Boy with a fish	Happy	Man's face, fish, boy's hands (2)	4	100%	3.9
Pageant winner	Happy	Crown, hand waving, flowers	3	100%	3.8
Girl with sports medal	Happy	"#1" finger, medal	2	100%	4
Children playing at the beach	Happy	Girl's face, boy's drink	2	100%	3.7
Girl being bullied	Sad	Other girls' faces (2), girls' hands pointing (2), target individual's hand raised to face	5	100%	3.5
Wrestling match	Sad	Opponent's raised arm, opponent's face, target individual's arm wrapped across body	3	91%	2.8
Three adolescents comforting each other	Sad	Boys' faces (2), girl's leaning posture	3	100%	4
Mother applying a band-aid	Sad	Women's faces (2), band-aid	3	82%	3.3
Boy pulling a girl's hair	Angry	Grip on hair, girl's face	2	55%	2.4
Children fighting over a teddy bear	Angry	Girl's face, hands pulling on bear (3)	4	100%	3.1
Mother pointing at child	Angry	Mother's face, mother's hand pointing, boy's crossed arms	3	45%[b]	3
Girls watching a movie	Fearful	Other girls' faces (2), target individual's crouched body position	3	100%	3.8
Spider	Fearful	Spider, man's face, arms restraining woman	3	91%	3.4

Table 4 continued

Image Content	Emotion	Relevant Areas	No. of Relevant Areas	Reliability Rating	Average Confidence Rating[a]
Infant receiving vaccination	Fearful	Infant's grip on parent, needle	2	82%	3.5
Girl holding a diaper	Disgusted	Diaper, hand reaching to face	2	100%	3.9
Man holding a shoe	Disgusted	Shoe, green "smell" vapor, hand to face, hand holding shoe	4	100%	4
Children at a water park	Surprised	Water stream, bucket	2	64%	2.8
Girl with headphones and woman in park	Surprised	Woman's face, girl's raised arm, headphones	3	64%	2.6
Girls peering into lunchbox	Surprised	Other girl's face, target individual's head and body leaning in	2	73%	2.3
Mother and daughter reading	No emotion	Mom's face, book	2	91%	2.2

[a]Average confidence rating of 11 respondents on 4-point confidence scale, 1-*not at all confident* to 4-*very confident*

[b]This image received 5 "angry" ratings, 5 "sad" ratings, and 1 "fearful" rating. The investigator chose to classify it as angry, but will exclude from analyses if less than 50% reliability is seen among control group participants.

Table 5

EK Task Performance and Relevant Area Gaze Duration Values

	ADHD (n = 19)	Control (n = 26)	Effect Size
Faces Percent Correct (%)			
Disgusted	49.82 (33.62)	61.54 (26.15)	-0.39
Happy	95.61 (7.54)	93.97 (10.20)	0.18
Mad	76.31 (19.50)	77.56 (18.22)	-0.07
Sad	60.18 (23.67)	59.62 (24.12)	0.02
Scared	58.77 (18.20)	62.82 (27.21)	-0.17
Surprised	77.02 (16.81)	82.69 (21.33)	-.030
Total Faces	70.23 (9.00)	74.03 (9.38)	-0.41
Situations Percent Correct (%)			
Disgusted	89.47 (20.94)	94.23 (16.29)	-0.25
Happy	85.53 (20.94)	94.23 (16.29)	-0.46
Mad	71.93 (22.94)	76.92 (20.59)	-0.23
Sad	79.82 (19.90)	79.81 (24.51)	0.00
Scared	84.21 (20.39)	84.62 (19.39)	-0.02
Surprised	57.89 (31.12)	61.54 (29.35)	-0.12
Total Situations	77.02 (12.01)	81.25 (11.97)	-0.35
[a]Faces AOI Proportion			
Disgusted	.48 (.13)	.51 (.12)	-0.24
Happy	.50 (.13)	.55 (.11)	-0.42
Mad	.60 (.15)	.65 (.11)	-0.38
Sad	.62 (.12)	.63 (.13)	-0.08
Scared	.67 (.14)	.67 (.10)	0.00
Surprised	.65 (.14)	.67 (.13)	-0.15
Total Faces	.59 (.11)	.61 (.09)	-0.20
[a]Situations AOI Proportion			
Disgusted	.78 (.09)	.79 (.09)	-0.11
Happy	.62 (.12)	.62 (.12)	0.00
Mad	.58 (.11)	.66 (.11)	-0.73
Sad	.55 (.11)	.58 (.10)	-0.29
Scared	.62 (.11)	.67 (.09)	-0.50
Surprised	.64 (.09)	.61 (.08)	0.35
Total Situations	.61 (.07)	.64 (.07)	-0.43

[a]Proportion of total time gaze duration that represents AOI gaze duration (i.e., AOI gaze duration/total image gaze duration)

Table 6
Correlations Between Demographic, EK, and Eye-Tracking Variables

	1	2	3	4	5	6	7	8	9	10
1. Age	-	.04	-.10	-.22	-.41*	.36*	.33*	.10	.34*	.40*
2. Gender		-	-.25	-.21	-.39*	.41*	.06	.11	.37*	.15
3.Parent DBD Inattention Count			-	.32*	.32*	-.24	-.07	-.10	.07	.06
4. Parent DBD ODD Count				-	.27	-.46*	.24	-.04	-.04	-.21
5. Teacher DBD Inattention Count					-	-.72*	-.28	-.27	-.09	-.07
6. TSSIS						-	.16	.07	.23	.11
7. Faces AOI Proportion							-	.20	.32*	.06
8. Situations AOI Proportion								-	.02	.16
9. Faces Percent Correct									-	.32*
10. Situations Percent Correct										-

Note: Gender is coded as males = 1 and females = 2.

Table 7

Hierarchical Linear Regression Results for EK Accuracy and AOI Gaze Duration

	Percent Correct for Faces Task		Percent Correct for Situations Task		Teacher SSIS Standard Score	
	R^2	β	R^2	β	R^2	β
Step 1						
Gender		0.38*		0.11		0.33*
Age		0.35*		0.37*		0.27*
Parent DBD ODD Symptoms						-0.33*
Step 1 R^2	.25**		.19*		.38**	
Step 2						
Parent DBD Inattention Symptoms		0.18		0.15		0.07
Teacher DBD Inattention Symptoms		0.28		0.24		-0.61**
Total Task(s) AOI Proportion		[a]0.28		[b]0.16		[c]-0.04
Step 2 R^2 Change	.13		.06		.24**	
Total R^2	.37		.27		.62**	

[a]Average Faces task AOI proportion
[b]Average Situations task AOI proportion
[c]Average proportion summed across both tasks
Note. * $p < 0.05$, ** $p < 0.01$. SSIS = Social Skills Improvement System.

APPENDIX A: PARENT REPORT MEASURES

Disruptive Behavior Disorders Rating Scale- Parent Report

Child ID# _____ Completed By (circle one): Mother Father Other_____

Date Completed: _____

Check the column that best describes your/this child. Write DK for items where you do not know the answer.	Not at all	Just a Little	Pretty Much	Very Much
1. often interrupts or intrudes on others (e.g., butts into conversations or games)				
2. often argues with adults				
3. often talks excessively				
4. is often easily distracted by extraneous stimuli or things unrelated to the task				
5. often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), e.g., runs into street without looking				
6. often fidgets with hands or feet or squirms in seat				
7. is often spiteful or vindictive				
8. often swears or uses obscene language				
9. often blames others for his or her mistakes or misbehavior				
10. often actively defies or refuses to comply with adults' requests or rules				
11. often does not seem to listen when spoken to directly				
12. often blurts out answers before questions have been completed				
13. often shifts from one uncompleted activity to another				
14. often has difficulty playing or engaging in leisure activities quietly				
15. often fails to give close attention to details or makes				

careless mistakes in schoolwork, work, or other activities				
16. is often angry and resentful				
17. often leaves seat in classroom or in other situations in which remaining seated is expected				
	Not at all	Just a Little	Pretty Much	Very Much
18. is often touchy or easily annoyed by others				
19. often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)				
20. often loses temper				
21. often has difficulty sustaining attention in tasks or play activities				
22. often has difficulty awaiting turn				
23. is often 'on the go' or often acts as if 'driven by a motor'				
24. often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)				
25. often runs about or climbs excessively in situations in which it is inappropriate				
26. often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
27. often deliberately annoys people				
28. often has difficulty organizing tasks and activities				
29. is often forgetful in daily activities				
30. often daydreams when should be attending				
31. often is sluggish or drowsy				

Thank you very much for your time and effort! We appreciate your assistance.

Impairment Rating Scale- Parent Report

Child ID: _____ **Form completed by (circle one)**: Mother Father Other:_____

Date Completed: _____

The following questionnaire is intended to assess potential problems that your child may or may not currently experience.
If you believe that your child is *not* experiencing social, emotional, or behavioral problems, make an "X" at the end of the line marked "no problem". If you believe that your child *is* experiencing any social, emotional, or behavioral problems, make an "X" on the line at the point that you believe reflects the impact of the child's problems in this area and whether he or she needs treatment or special services.

(1) How your child's problems affect his or her relationship with playmates.

No Problem |_____| Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

1a. Regardless of whether this child is popular or unpopular with peers, does he or she have a special, close "best friend" that he or she has kept for more than a few months? (Please circle)

YES NO

1b. How your child's problems affect his or her relationship with brothers or sisters.

(If has no brothers or sisters, check here and skip to #2)

No Problem |_____| Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

(2) How your child's problems affect his or her relationship with you (and your spouse if present).

No Problem |_____| Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

(3) How your child's problems affect his or her academic progress at school.

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

(4) How your child's problems affect his or her self-esteem.

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

(5) How your child's problems affect your family in general.

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

(6) Please mark an "X" on the following line at the point that you believe reflects the overall severity of this child's problem in functioning and overall need for treatment.

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

Social Skills Improvement System Rating Scale- Parent Report

Each item is rated on a scale of how often (*Never, Seldom, Often, Almost Always*) the behavior occurs and how important (*Not Important, Important, Critical*) the parent thinks the behavior is for the child's development. Because the measure is copyrighted and available only after purchase, items are not listed

APPENDIX B: TEACHER REPORT MEASURES

Disruptive Behavior Disorders Rating Scale- Teacher Report

Teacher ID# _____ Date Completed: _____

Check the column that best describes your/this child. Write DK for items where you do not know the answer.	Not at all	Just a Little	Pretty Much	Very Much
1. often interrupts or intrudes on others (e.g., butts into conversations or games)				
2. often argues with adults				
3. often talks excessively				
4. is often easily distracted by extraneous stimuli or things unrelated to the task				
5. often engages in physically dangerous activities without considering possible consequences (not for the purpose of thrill-seeking), e.g., runs into street without looking				
6. often fidgets with hands or feet or squirms in seat				
7. is often spiteful or vindictive				
8. often swears or uses obscene language				
9. often blames others for his or her mistakes or misbehavior				
10. often actively defies or refuses to comply with adults' requests or rules				
11. often does not seem to listen when spoken to directly				
12. often blurts out answers before questions have been completed				
13. often shifts from one uncompleted activity to another				
14. often has difficulty playing or engaging in leisure activities quietly				
15. often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities				

16. is often angry and resentful				
17. often leaves seat in classroom or in other situations in which remaining seated is expected				
	Not at all	Just a Little	Pretty Much	Very Much
18. is often touchy or easily annoyed by others				
19. often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)				
20. often loses temper				
21. often has difficulty sustaining attention in tasks or play activities				
22. often has difficulty awaiting turn				
23. is often 'on the go' or often acts as if 'driven by a motor'				
24. often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)				
25. often runs about or climbs excessively in situations in which it is inappropriate				
26. often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)				
27. often deliberately annoys people				
28. often has difficulty organizing tasks and activities				
29. is often forgetful in daily activities				
30. often daydreams when should be attending				
31. often is sluggish or drowsy				

Thank you very much for your time and effort! We appreciate your assistance.

Impairment Rating Scale- Teacher Report

Teacher ID: _____ **Date Completed: _____**

The following questionnaire is intended to assess potential problems that your child may or may not currently experience.
If you believe that your child is *not* experiencing social, emotional, or behavioral problems, make an "X" at the end of the line marked "no problem". If you believe that your child *is* experiencing any social, emotional, or behavioral problems, make an "X" on the line at the point that you believe reflects the impact of the child's problems in this area and whether he or she needs treatment or special services.

(1) How this child's problems affect his or her relationship with other children

No Problem _____
Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

1a. Regardless of whether this child is popular or unpopular with peers, does he or she have a special, close "best friend" that he or she has kept for more than a few months? (Please circle)

YES

NO

(2) How this child's problems affect his or her relationship with the teacher

No Problem _____
Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

(3) How this child's problems affect his or her academic progress.

No Problem _____
Extreme Problem
Definitely does not need treatment or special services — Definitely needs treatment or special services

(4) How this child's problems your classroom in general

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

(5) How this child's problems affect his or her self-esteem.

No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

(6) Please mark an "X" on the following line at the point that you believe reflects the overall severity of this child's problem in functioning and overall need for treatment.

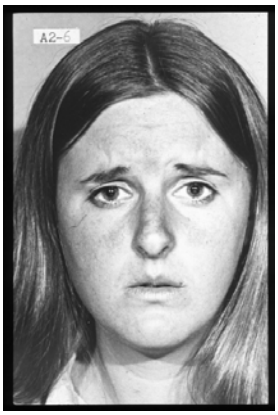
No Problem
Extreme Problem
Definitely does not need treatment or special services
Definitely needs treatment or special services

Social Skills Improvement System Rating Scale- Teacher Report

Each item is rated on a scale of how often (*Never, Seldom, Often, Almost Always*) the behavior occurs and how important (*Not Important, Important, Critical* the teacher thinks the behavior is for the child's development). Because the measure is copyrighted and available only after purchase, items are not listed

APPENDIX C: EYE-TRACKING STIMULI

Pictures of Facial Affect (POFA)



Internet Image

APPENDIX D: PHONE SCREEN

Understanding Academic, Social, and Emotional Skills in Elementary School Children

Phone Screen

"Hi, thank you for calling in response to the flyer you received. I'd be happy to provide you with more information about the study. Do you have a few minutes?

Continue:

The Center for Intervention Research in Schools (CIRS) at Ohio University is conducting a study on the academic, social, and emotional skills of children. As part of this effort, we are recruiting children between the ages of 8 and 11 to participate.

If you agree to participate, you and your child will be asked to attend a study session where you will complete questionnaires and an interview that ask about your child's developmental history, mental health, and problems he/she may be having. Your child will also be asked to complete questionnaires, view pictures of different facial expressions and scenes, and complete a language-decoding task. Your child's teacher would also be asked to complete questionnaires about your child's behavior and functioning at school. The study session should take 2-3 hours. Following the session you will receive $50 compensation for your time and travel. Does this sound like something you would be interested in doing?

If yes:

"Great, let me start by getting some information from you to determine if your child is eligible to participate. If so, then we can schedule a time to meet for the study session!"

If no:

"Alright, would you like me to leave our number in case something changes? Okay, well I thank you for your interest in our program and I appreciate your time."

Staff: _____ _____ Date: _____

How did you find out about this study? Flyer, Email, etc. _____

Child's Name: **ID:**
Sex : M or F **Child Between 8 and 11? YES *NO Date of Birth** : **If child will be 8 by the time of the scheduled evaluation, then family is eligible. If child will be 8 years old before 4/31/2013, ask for permission to call them back at that time to schedule an appointment. Collect contact info.*
Is the child currently being home schooled? *YES NO *If yes, then the child is ineligible. **School:** **Teacher:** **Grade this school year**:
Has your child ever been diagnosed with Autism, Pervasive Developmental Disorder or a Mental handicap/Mental retardation?* No Yes **(Not eligible)** **Has your child ever been diagnosed with a severe visual or hearing impairment?** No Yes **(not eligible)** _____ _____
Time of Evaluation: _____ AM/PM **Date**:
Parent Name: *Legal guardian must be present*
Email: Home Phone: **Work Phone:** **Cell Phone:**
Mailing Address: *In order to send their letter*
Alternate Contact: **Phone:**

*If the student does not meet preliminary inclusion criterion because they have been or are currently home schooled, do not meet age requirements, or are diagnosed with Autism, PDD or MR, or have a severe hearing or visual impairment, thank the parent for their time and let them know they are not eligible for participation.

Has your child been diagnosed with ADHD? YES NO

If NO, continue to ask the next questions. If YES, skip the questions, and schedule evaluation

Now, I am going to ask you a few quick questions that ask about (child's name) behavior. You can decide whether or not you would like to answer the questions. Any information you provide will remain completely confidential.
For the behaviors that I mention, please tell me how often this happens for (child's name), using a scale from 1 to 4, where 1 means "Not at all," 2 means "Just a little", 3 means "Pretty Much" and 4 means, "Very Much."

Questionnaire for Symptoms of Inattention

	Not at all	Just a little	Pretty Much	Very Much
Does not pay attention to details and makes careless mistakes, for example, with homework				
Has difficulty keeping attention to what needs to be done				
Does not seem to listen when spoken to directly				
Does not follow through when given directions and fails to finish activities				
Has difficulty organizing tasks or activities				
Avoids, dislikes, or does not want to engage in tasks that require ongoing mental effort				
Loses things necessary for tasks or activities such as pencils, books, or assignments				
Is often easily distracted (by extraneous stimuli)				
Is forgetful in daily activities				

Count one point each time a statement is answered, "pretty much", or "very much".

***Total Score:* _____**

"Thank you for answering those questions. We can move on to schedule an appointment for an initial evaluation, now, if you would like. "

If the parent schedules an appointment inform them about:

- The 12-hour medication hiatus **only if** the child is taking stimulant medication
    - "Your child will be required to take a 12-hour break from his/her stimulant medication before coming to the session. This means when you arrive for the session, your child has not had a dose of stimulant medication in the past 12 hours. Only take this break in medication if your child's doctor has said it is okay to miss a dose or okay to take a break, or 'medication holiday'. Do you think you and your child will be able to take a 12-hour break in medication for the session?
        - If no, "The medication break is a requirement of the study, so if your child cannot take a break from his/her medication we won't be able to schedule an appointment. Thank you for your time. If anything changes, please contact us at (740) 597-3236.
        - If yes, "We will include a reminder about the medication break in our confirmation letter and in the reminder call"

  Those parents of children who are taking a non-stimulant medication for ADHD such as Strattera, and Intuniv, are to be informed that they cannot participate in the study *at all.*

- That teacher will be contacted to complete study measures
    - "We will contact your child's teacher, (insert teacher name), to complete some questionnaires for the study. These questionnaires will ask about your child's behavior and functioning at school.
- If the parent cannot complete a 3-hour session, ask them if they would like to split the procedures into two sessions. The first session would be 2-hours and they would receive half of the payment, and the second session would be 1 hour and they would receive the other half of the payment at that time.

End with:

"Your session may take a bit longer than your son/daughter's. Feel free to bring a book or something else to occupy your child's extra time. You will be getting a confirmation letter in the mail that will include directions and the details of your appointment. Please do give us a call if you do not receive this or if you have any questions/concerns. May I leave our number? It's (740) 597-3236."

APPENDIX E: CONSENT AND ASSENT FORMS

Teacher Consent Form

Ohio University Consent Form
The Relationship Between Visual Attention and Emotion Knowledge in Children

Title of project: The Relationship Between Visual Attention and Emotion Knowledge in Children
Researchers: Verenea Serrano, Dr. Julie Owens, and Dr. Brooke Hallowell

You are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you

What is the purpose of the project?

- The goal of this study is understand the relationship between where children look when viewing a picture and their accuracy in identifying emotions.
- Additionally, we want to compare different measures of attention to see which better predicts a child's emotion knowledge.

What will the project involve? The project will involves elementary school students, their parents, and their teachers. If you agree to participate, you will complete questionnaires about your student's behavior, social skills, and academic skills at school.

The child and his/her parent will participate in an evaluation process, and part of this process includes questionnaires completed by the child's teacher. After the parent and child have been enrolled in the project, you will be contacted to complete the questionnaires.

How will information be kept private? All information gathered will be kept strictly confidential. Your name will not appear on any of the project materials; instead, you will be assigned a code number that will identify the materials. If for some reason, you choose to discontinue with the research project, de-identified assessment data will be maintained in the project database, unless you explicitly request otherwise. The master list (the list of participant codes and identifying information) of all program participants will be stored in a password-protected file on a secured drive at Ohio University. The master list will be destroyed in June of 2014 (approximately one year after the completion of the project). While the above-described efforts will be taken to keep your study-related data

confidential, there may be circumstances where your name must be shared with offices on campus, including the Ohio University Institutional Review Board, a committee that oversees research at OU, and OU Office of Finance, that oversees payment of participants.

What are the potential risks? There are few risks to teachers participating in this project. Primarily, you may not enjoy completing the rating scales.

What are the benefits? There are no direct benefits to teachers. However, information obtained from this project may be beneficial to children with ADHD. Our findings will help understand how inattention affects emotion knowledge and social functioning, and these results may help develop future interventions.

How will you be compensated? You will receive $15 for completing the questionnaires. Compensation will be provided after completion of the questionnaires.

Am I required to participate? Participation is completely voluntary. You are free to stop participation at any time without prejudice. If you have any concerns regarding this project, please contact Verenea Serrano, 740-597-2925 (vs198311@ohio.edu) or Dr. Julie Owens, 740-593-1707 (owensj@ohio.edu). Additionally, if you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, 740 593-0664.
By signing below, you are agreeing that:

- You have read this consent form (or it has been read to you) and you have been given the opportunity to ask questions
- The known risks to you have been explained to your satisfaction
- You understand that Ohio University has no policy or play to pay for any injuries that you might receive as a result of participating in this project
- You are 18 years or older
- Your participation is given voluntarily
- Your may change your mind and stop participating at any time without penalty or loss to which you may otherwise be entitled

_____ _____

Name -- Please Print Signature Date

Parent Consent Form

Ohio University Consent Form
The Relationship between Visual Attention and Emotion Knowledge in Children

Title of the project: The Relationship Between Visual Attention and Emotion Knowledge in Children
Researchers: Verenea Serrano, Dr. Julie Owens, and Dr. Brooke Hallowell

You and your child are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow you and your child's participation in this study. You should receive a copy of this document to take with you.

What is the purpose of the project?

- The goal of this study is to understand the relationship between where children look when viewing a picture and accuracy in identifying emotions.
- Additionally, we want to compare different measures of attention to see which better predicts a child's emotion knowledge.

What will the project involve? The project will involves elementary school students, their parents, and their teachers. If you agree to participate, the following activities will be performed:

- You will complete:
    - A demographic questionnaire
    - An interview in which you will be asked questions about your family, your child's development, possible behaviors your child may be demonstrating, any medications he or she is taking, and about other mental health and medical history.
    - Questionnaires about your child's behavior, social functioning, and academic functioning at school and home.
- Your child will complete:
    - Tests of cognitive abilities
    - Tasks requiring him/her to view various pictures of facial expressions and emotional situations while his/her eye locations are monitored with cameras
- Your child's teacher will complete:
    - Questionnaires about your child's behavior, social skills, and academic skills at school.

These tests will be completed during your study session appointment. Completing all the measures will take about 2 hours. Please note these above procedures represent an evaluation for ADHD, not a comprehensive mental health evaluation.

If your child is taking medication for ADHD (e.g., Ritalin), your child will be asked to take a 12-hour break from this medication before the study session. However, a break in medication should only occur if your child's physician has indicated such breaks in medication are safe (e.g., that it is acceptable to miss a dose).

How will information be kept private? You, your child and your child's teacher are guaranteed complete confidentiality regarding the assessment and questionnaire responses that you provide. Children's names, parents' names and teacher's names will not appear on these materials; instead, each child will be assigned a code number that will identify the materials. You agree that scientific data not identifiable with the children involved in the project may be presented at meetings and published so that the information from the project can be useful to others. If for some reason, you chose to discontinue with the research project, de-identified assessment data will be maintained in the project database, unless you explicitly request otherwise. The master list (the list of participant codes and identifying information) of all program participants will be stored in a password-protected file on a secured drive at Ohio University. The master list will be destroyed in June of 2014 (approximately one year after the completion of the project).

While not anticipated, project investigators are required to break confidentiality if one of the following situations occurs:

- If you, as legal guardian give written permission to release the information
- If you or your child reveals information that, in program staff's judgment, indicates that your child intends to harm self or someone else. (See A below)
- If you or your child reveals information that indicates the existence of past or present child abuse or neglect, as required by The Ohio Child Abuse and Neglect Law (See B below)
- If an appropriate court order is received by a member of our program staff (See C Below)

*Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

* A: A licensed clinician who is part of the research staff may be consulted for further action if you reveal harm to yourself or others, or if you have revealed information that indicates past or present child abuse.
* B: The Child Protective Services in the county in which you reside.
* C: The court from which a court order was received.
* D: In a medical emergency, medical personnel who would need information to care for your child; including emergency vehicle service personnel, hospital emergency department staff.
* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;

* Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU.

Finally, there may be circumstances that are out of our control in which your confidentiality is compromised.

What are the potential risks? The questionnaires pose no risk or threat to participants. The nature of some of the questions may produce discomfort in some individuals. Clinical staff will be available should you have any questions or concerns. The strategies used in the project have previously been used safely and effectively with children who have problems with inattention, hyperactivity/impulsivity, and/or getting along with others.

What are the benefits? Information obtained from this project may be beneficial to other children with ADHD. Our findings will help understand how inattention affects emotion knowledge and social functioning, and these results may help develop future interventions. Benefits expected for parents include a free evaluation for ADHD.

How will you be compensated? You will receive a $50 stipend for participating. Compensation will be provided at the end of the study session. Your child will receive a small toy as a token of appreciation for his/her participation.

Is my child required to participate? Participation is completely voluntary and will not prejudice present or future relationships you have with your child's elementary school or any community agency, and not will influence the quantity or quality of care that is otherwise available to children in the school or community. If you and your child agree to participate, you and/or your child are free to stop participation at any time without prejudice, and withdrawal in no way affects the nature of the care or services otherwise available to children and families.

If you have a question about this project please contact Verenea Serrano, 740-597-2925 (vs198311@ohio.edu) or Dr. Julie Owens, 740-593-1707 (owensj@ohio.edu). Additionally, if you have any questions regarding children's rights or parent's rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, 740 593-0664. By signing below, you are agreeing that:

- You have read this consent form (or it has been read to you) and you have been given the opportunity to ask questions
- Known risks to you and your child have been explained to your satisfaction
- You understand that Ohio University has no policy or play to pay for any injuries that you or your child might receive as a result of participating in this project
- You are 18 years or older and the legal guardian of the child participant
- Your participation is given voluntarily
- You and/or your child may change your mind and stop participating at any time without penalty or loss to which you may otherwise be entitled
- You give permission for your child's teacher and school to release any and all

information regarding your child's behavior and academic performance.

- You agree that scientific data not identifiable with you or your child may be presented at meetings and published so that the information from the project can be useful to others

_____	_____
Child's Full Name -- Please Print	Child's Date of Birth

_____	_____	
Parent/Guardian Name – Please Print	Parent/Guardian Signature	Date

Child Assent Form

Ohio University Assent Form
The Relationship Between Visual Attention and Emotion Knowledge in Children

I know that I am being asked to do a project today. Here is a little bit about the project:

- I will be see pictures of people and be asked questions about the pictures.
- I know that my parents have said it was ok for me to be in the project
- I know that I do not have to do this project if I do not want to, and I can stop being in the project at anytime and that is ok.
- I know that I will receive a small toy as a thank you for helping with the project.

If I have any questions about the project, I can ask my parents or the project staff at any time.

Please put a checkmark next to ONE sentence

_____ I agree to be a part of the project

_____ I do not want not to be a part of the project

Thesis and Dissertation Services