RECOGNITION OF FACIAL AFFECT IN ADULTS WITH ATTENTION PROBLEMS

by

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Master of Arts
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DEDICATION

This is dedicated to my best friend and loudest cheerleader, my mom, Mamie Fields.

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ABSTRACT

RECOGNITION OF FACIAL AFFECT AND ADHD SYMPTOMS IN ADULTS

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Numerous researchers have found that individuals with ADHD tend to have more interpersonal difficulties than those without the disorder. However, it is unclear why. A study by Rapport et al. (2002) may have provided a clue by discovering that adults with ADHD were less accurate when interpreting facial emotional expressions. The present study sought to corroborate the findings by Rapport et al. (2002) with a non-clinical sample and to extend those findings by examining the relationship between facial affect recognition, reported relationship satisfaction, and communication competence. A convenience sample of 128 undergraduates at George Mason University was separated into two groups, one with relatively elevated scores on the Conners' Adult ADHD Rating Scale, Self-Report Screening Version (CAARS-S:SV; *T*-scores of 60 or greater) and a group with relatively lower scores on the CAARS-S:SV (*T*-scores ≤59). No group differences were found in the performance accuracy or the reaction times on a facial affect recognition task and a face labeling control task. The first group reported more

depression, anxiety and less life satisfaction than the second or comparison group. Secondary analyses performed with a subset of participants from the ADHD group who had clinically significant CAARS-S:SV *T* scores (n = 25; *T*-score ≥ 65) indicated that when they were compared to the comparison group and the participants with subclinical symptoms of ADHD, these participants demonstrated deficits in affect recognition for the emotions happy and sad. In addition, the Clinical group had statistically significantly higher depression and anxiety scores, and reported lower life satisfaction and interpersonal communication competence when compared with participants who reported subclinical symptoms.

Description of the Disorder

Attention Deficit Hyperactivity Disorder (ADHD) is a disorder most frequently diagnosed in childhood that produces enduring difficulties in academics, interpersonal relationships, and vocations. Although there has been extensive research on the symptoms of inattention and hyperactivity characteristic of school-aged children with ADHD, research examining the impact of attention problems in adulthood is less extensive.

ADHD is often characterized by externalizing behaviors which are disruptive in multiple settings, such as school and home, and in excess of that which is age-appropriate. Although the diagnostic criteria have changed over the years with newer editions of the Diagnostic and Statistical Manual, ADHD has been consistently associated with high energy level, poor organization, impaired social judgment, impulsivity, and frequent shifting of attention. The symptoms of ADHD are divided into behaviors of inattention, hyperactivity, and impulsivity, with children who have the disorder demonstrating some combination of these behaviors (Campbell, 2000; APA, 2000).

Diagnostic Criteria

The most recent edition of the DSM separates ADHD into three subtypes that have been substantiated by empirical research (e.g. Frick & Lahey, 1991; Teeter & Semrud-Clikeman, 1997) – predominantly hyperactive type, predominantly inattentive

type, and combined type (APA, 2000). Children receive a diagnosis of predominantly hyperactive type if they demonstrate six or more of the symptoms of hyperactivity/impulsivity, but fewer than six for inattention and receive a diagnosis of predominantly inattentive type if they demonstrate six or greater inattentive symptoms but are below the threshold for hyperactivity/impulsivity. Children demonstrating six or more symptoms of both inattention and hyperactivity/impulsivity receive a diagnosis of combined type. Inattentive symptoms include inattention to detail, difficulty completing tasks, difficulty sustaining attention, appearing not to listen when spoken to, difficulty organizing tasks or activities, avoiding work requiring sustained mental effort, losing things which are necessary for tasks or activities such as books or toys, being easily distracted, and forgetfulness. Hyperactive/impulsive symptoms include fidgeting, out of seat behavior when inappropriate, running about excessively, difficulty playing quietly, acting as though "driven by a motor," talking excessively, blurting out answers before questions are completed, having difficulty waiting for his or her turn, and butting in on conversations or activities (APA, 2000; Goldstein, 1997). Children with predominantly hyperactive type ADHD have been found to demonstrate greater impulsivity, distractibility, aggression, and conduct problems than those with predominantly inattentive type ADHD (Cantwell & Baker, 1992).

Etiology

While there are a variety of theories which attempt to answer the question of the etiology of ADHD, there is no one conclusive answer. Barkley (1997) proposes that behavioral inhibition is the core deficit in hyperactive ADHD. This model has received

some support from biological evidence attempting to identify key brain regions and neurotransmitters associated with these deficits (Zametkin et al., 1993). In addition, other researchers have located significant brain abnormalities in children with ADHD when compared to controls (Willis & Weiler, 2005; Rubia, Smith, Brammer, Toone, & Taylor, 2005; Plessenet et al., 2006). For example, Hill et al. (2003) found that in a sample of children with ADHD with no comorbid learning disabilities, the children in the ADHD group demonstrated smaller total brain volume, superior prefrontal cortex volume, and right superior prefrontal cortex volume in addition to significantly smaller areas for the corpus callosum and parts of the cerebellum. These brain regions are associated with arousal, integration of sensory perception and motor outputs, and executive functions, such as being able to predict the future consequences of behavior, and the suppression of socially inappropriate urges, all of which are associated with behavioral difficulties which characterize ADHD (Gazzaniga, Ivry, & Mangun, 2002).

There is also significant evidence supporting a genetic component to the development of ADHD (APA, 2000; Teeter & Semrud-Clikeman, 1997; Campbell, 2000). First-degree relatives of children with ADHD are four times more likely to have ADHD than those without a positive family history. Siblings and parents of children with ADHD were more likely to have or have had the disorder themselves. Also, having either a monozygotic or dizygotic twin with ADHD increases the likelihood of being diagnosed with the disorder (Knopik et al., 2005). Recent twin studies lend further support to the hypothesis of a genetic component to ADHD, demonstrating that there are higher rates of concordance for ADHD among monozygotic than dizygotic twins (Levy

et al., 1997; Zahn-Waxler et al., 1996). There is evidence that other biological factors can increase the risk of developing ADHD. For example, children whose parents suffer from alcoholism and those who experience prenatal exposure to alcohol and nicotine are at increased risk of being diagnosed with ADHD (Knopik et al., 2005). Low parental education level is also related to ADHD diagnosis (St. Sauver, Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2004). However, the impact of other pregnancy and labor characteristics, such as birth weight, is inconclusive.

In addition to the genetic component, children with ADHD are also more likely to experience parenting practices that are associated with hyperactivity and may increase or sustain hyperactive and other problem behaviors. For example, Keown and Woodward (2002) found that parents of preschool boys with increased hyperactivity were more likely to use lax disciplinary practices, have less efficient parental coping, had lower rates of father-child communication, and had less synchronous mother-child interactions. Also, there have been findings of increased family discord, family stress, and more use of authoritative parenting practices, including greater use of commands and fewer positive, supportive responses to compliant behavior (see Campbell, 2000, for a review). Similarly, Biederman, Faraone, and Monuteaux (2002) found that parental ADHD was associated with disruptive family environment and their offspring were at increased risk of ADHD and reduced school performance.

There is also evidence that parents of children with ADHD differ from other parents in their ways of explaining children's positive and negative behaviors. For example, Johnston and Freeman (1997) found that while parents of children with ADHD

and parents of controls were both more likely to attribute prosocial child behaviors to internal, controllable, and stable causes, parents of children with ADHD were more likely to attribute negative behaviors to factors internal to the child and enduring over time. They also tended to attribute positive child behavior to factors external to the child and less stable and controllable. These patterns of attributions may lead to the parenting practices described above, such as the reduced use of positive reinforcers to appropriate behaviors and more punishers in response to inappropriate behaviors. Harsh parenting practices such as criticism and rejection and low parental warmth have been found to be predictive of childhood depression, externalizing problems, and delinquent behavior (Sroufe, Duggal, Weinfield, & Carlson, 2000; Dodge, 2000; Oldehinkel, Veenstra, Ormel, de Winter, & Verhulst, 2006).

Prognosis and Developmental Trajectory

Despite the use of these categories, ADHD is a heterogeneous disorder with children showing a variety of symptoms or behavior problems depending on the child, the situation, or the child's age (Barkley, 1998; Drechsler, Brandeis, Földényi, Imhof, & Steinhausen, 2005; Biederman, Mick, & Faraone, 2000). In their longitudinal study of children from late childhood to early adolescence, Drechsler et al. (2005) found that differences between children with ADHD and controls were most pronounced at time one (participants' mean age = 10.8 years), but that many were still present at time two (participants' mean age = 12.0 years) and reduced, but still present, at time three (participants' mean age = 13.3 years), including increased reaction time variability on a computerized continuous performance task and increased number of errors on a task of

behavioral inhibition. This suggests that even within individual children, symptoms can change dramatically over the course of development.

Even individuals who do not have significant symptomatology to warrant a diagnosis of ADHD can have significant deficits in multiple settings and throughout development (Doyle, Biederman, Seidman, Reske-Nielsen, & Faraone, 2005; Eiraldi et al., 2005; Marks et al., 2005). In their study of a community sample, Scahill, Schwab-Stone, Merikangas, Leckman, Zhang, and Kasl (1999) found that children with subthreshold ADHD (N = 100) had symptomalogy which was significantly distinct from children with clinical levels of ADHD (N = 85) and normal controls (N= 260) and with symptoms sufficient to cause difficulties in multiple settings. Similarly, Eiraldi et al. (2005) found that girls with subthreshold ADHD which was defined as having 4 to 5 symptoms of ADHD were impaired in social and academic skills. Also, 82% of girls with subthreshold inattention and 84% of girls with subthreshold hyperactivity/impulsivity demonstrated impairment in at least two settings. Doyle, et al. (2005) found that unaffected (i.e. without a diagnosis of ADHD) relatives of girls with ADHD demonstrated impairments on some tasks of executive functioning. Although these individuals' symptoms did not warrant diagnoses of ADHD, research suggests that children and adults with subthreshold symptoms also experience deficits and may be able to benefit from interventions or accommodations.

ADHD-related difficulties are believed to continue to impact individuals with ADHD throughout development in vocational, educational, and social settings. For example, boys with childhood ADHD have been found to complete significantly less

formal schooling than controls and to obtain jobs with lower occupational rank than controls (Mannuzza et al. 1991). Even when individuals with ADHD pursue postsecondary education, their academic problems continue to persist (Wilens, Faraone, & Biederman, 2004; Richard, 1997). In Mannuzza's (1991) sample, while none of the participants with ADHD obtained Master's degrees or law degrees, four percent of controls had. The highest grade completed for controls was 15.1, compared with 12.9 for those with history of ADHD. Eighty-five percent of controls were employed, compared with 79% of the ADHD group.

Epidemiology of ADHD

ADHD is estimated to have a prevalence of between 3 and 5 percent of children; however, there are sex differences in prevalence for the disorder as a whole and its subtypes (Campbell, 2000). Males are far more likely to be diagnosed with ADHD with male to female ratios ranging from 2:1 to 9:1 (APA, 2000). The sex differences vary substantially depending on the subtype, with the sex ratio being less pronounced for inattentive than combined or hyperactive types. Girls are more likely to receive a diagnosis of the inattentive subtype, while boys outnumber girls for the hyperactive subtype (Sameroff, Lewis, & Miller, 2000). Sex differences are also reported to be particularly strong when teacher reports are used to identify children with ADHD (Campbell, 2000).

ADHD is most often diagnosed early in childhood around age seven or eight (APA, 2000). While children may be suspected of having ADHD prior to this age, diagnoses are far more difficult to establish due to reduced number of demands on young

children and increased variability in their behavior. Symptoms of ADHD become most apparent during the early elementary years when children are required to attend to lectures and activities for extended periods and remain seated for hours at a time. The child with ADHD finds these demands far more difficult than the typical child. Hyperactive children appear disruptive in elementary school classrooms, leaving their seats inappropriately, impulsively joking or commenting, breaking classroom rules, or fidgeting. Inattentive children tend to be less disruptive, but still have significant difficulties in class. These children miss instructions, lose books and assignments, forget to complete tasks, and are often distracted by external and internal stimuli.

Impulsive behaviors, which are characterized as impairments in behavioral inhibition, the ability to inhibit a behavior when it is appropriate to do so, are seen by some researchers as a primary characteristic of the disorder, particularly the hyperactive subtypes (Barkley, 1997; Teeter & Semrud-Clikeman, 1997). Specifically, Barkley (1997) links behavioral inhibition to four functions – working memory, self-regulation, internalization of speech, and reconstitution (behavioral analysis and synthesis). He suggests that deficits in behavioral inhibition impair an individual's ability to inhibit prepotent responses (i.e., responses that have previously been associated with reinforcement), stop ongoing responses, and control interference or their distractibility. These deficits produce the secondary deficits in functions such as organization, planning, inhibiting motor behaviors, or focusing attention. Individuals with ADHD are also impaired in their use of working memory. They struggle to hold events in mind, have an impaired sense of the passage of time, and struggle to initiate complex behavior

sequences. Self-regulation deficits are demonstrated through impaired emotional self-control and internal regulation of motivation. Internalization of speech, which facilitates rule-governed behavior, problem-solving, and moral reasoning, and reconstitution, which is implicated in behavioral and verbal creativity, are found to be impaired in individuals with ADHD (Barkley, 1997). Deficits in these functions are posited to be related to deficits in multiple areas of functioning in persons with ADHD.

There is a large body of research demonstrating that children with ADHD demonstrate deficits on a variety of tasks and in academic and non-academic settings; therefore, only a brief review will be offered. It is widely accepted that children with ADHD perform more poorly than normal controls on tasks of executive function, a set of cognitive functions which enable efficient, goal-directed behaviors (Scheres et al., 2004). While some variability has been found in the particular executive functions on which children with ADHD have deficits, it has been well established that children with ADHD struggle with tasks of sustained attention, behavioral inhibition, and working memory (Scheres et al., 2004; Shallice et al., 2002; Teeter & Semrud-Clikeman, 1997; Weyandt, 2005; Barkley, 1997).

In a study of attention processes, Brewer, Fletcher, Hiscock, and Davidson (2001) compared children with ADHD, shunted hydrocephalus, and normal controls. They had subjects complete a variety of attention tasks chosen to reflect Mirsky's (1991) factor analysis-based model of attention which proposes four elements of attention – focus/execute, sustain, encode, and shift. Focus-execute refers to the capacity to concentrate one's cognitive resources on a particular task. Sustain refers to the ability to

maintain focus over time. Encoding is one's ability to interpret the information acquired and shift is the ability to change one's attention focus flexibly. Researchers recruited seventy-three children diagnosed with ADHD - combined type from neuropsychology clinics, and had them complete a visual orienting and detecting task, a continuous performance task (CPT), the Wisconsin Card Sort Task (WCST), and the Wechsler Intelligence Scale for Children – Revised (WISC-R). While children with ADHD did not perform worse than controls on the WISC-R, they performed significantly worse than controls and, in some cases, worse than the other clinical group, on tasks of attention. Specifically, they tended to have slower reaction times on the visual orienting task and increasing reaction times over time compared to both other groups. Children with ADHD also had slower overall reaction times than controls on the CPT. On the WCST, children with ADHD made fewer correct responses and made more total errors than controls. They also made more perseverative errors on the WCST than children in both other groups. The results from this study suggest that children with ADHD have difficulty attending to a tedious task to perform efficiently, particularly over extended periods. As a result, they are more prone to errors than their peers and take longer to learn from their mistakes.

In two combined studies by Biederman et al. (2004), 258 children with ADHD and 225 normal controls completed a battery of executive and achievement tasks including the Rey Osterrieth Complex Figure, Wisconsin Card Sorting Test, Wide Range Achievement of Memory and Learning test, the Stroop test, and selected subtests from the Wechsler Intelligence Scale for Children – Third Edition. Analyses indicated that

thirty-three percent of children with ADHD were classified as having executive function deficits, indicated by below average scores on two or more executive tasks. This was significantly above the rate of 12% of normal controls found to have executive function deficits.

In a very interesting study by Lawrence et al. (2002), children with ADHD were compared with normal controls while completing several real-life executive tasks rather than the less ecologically valid tasks typically used in laboratories. Although many researchers have found in studies of children with ADHD that they demonstrate deficits on experimental tasks such as computerized continuous performance tasks and highly structured executive tasks, this study varied from that formula by requiring children to perform executive tasks such as inhibiting a prepotent (previously reinforced) response, focusing on a task, and ignoring extraneous stimuli while playing videogames and following a sequential route through a zoo. Children played two videogames. The first, Point Blank, required them to aim at and hit round black and white bull's-eyes within a limited time period, while the second, Crash Bandicoot, required them to negotiate a character through a series of hazards moving along a path. The first game required inhibiting responding to increase accuracy, while the second required inhibition of a response, stopping one's character on the screen to avoid hazards, and included a varying working memory load. The researchers also included a distracter in the form of a television show segment on a nearby monitor. The zoo component required participants to follow two routes through the zoo, a simple route, which was shorter and had few distractions, and a complex route, which was longer and required children to pass

multiple distractions such as an enclosure with baby penguins with sounds triggered by their approach and a waterfall. It was hypothesized that given the poorer behavioral inhibition of children with ADHD, these children would have particular difficulty ignoring salient distractions within the executive tasks. Therefore, children with ADHD would be expected to look away from videogame play at the television or wander off the zoo path when distracted by interested sounds or sights. Children were instructed to complete each route as quickly as possible. Children with ADHD demonstrated more self-talk and made more excited vocalizations during videogame play and took longer to complete the game with a greater working memory load. There was also a significant interaction between group and route complexity on the zoo task indicating that children with ADHD had more difficulty following the complex route. These children made more deviations from the route and took longer than controls to reach the final destination. However, there were no differences between children with ADHD and controls in the frequency of off-task glances during the videogame play or in accuracy of shots during the Point Blank game or behavioral inhibition on the Crash Bandicoot game. These findings suggest that children with ADHD demonstrate deficits on executive tasks, particularly those assessing working memory and inhibition, even when completing child-preferred, enjoyable tasks; however, these deficits can vary depending on the structure and attractiveness of the task at hand, such that highly attractive tasks with lots of immediate reinforcement may leave children less vulnerable to distractions.

Comorbidity

Children who receive diagnoses of ADHD are more likely to receive other mental health diagnoses. Epidemiological studies indicate that over half of the children diagnosed with ADHD also meet criteria for another disorder (Biederman & Faraone, 2005). These children are more likely to be diagnosed with externalizing disorders, such as oppositional defiant disorder (ODD) and conduct disorder (CD), and internalizing disorders, such as depression and anxiety disorders (Campbell, 2000). In fact, research suggests a high degree of overlap between the symptomatology of ADHD and other externalizing and internalizing disorders (Fischer et al., 2005; Hinshaw, 1992; Treuting & Hinshaw, 2001; Campbell, 2000; Biederman et al., 1993). Jensen, Shervette, Xenakis, and Richters (1993) compared 47 children with ADHD to 47 controls from their community sample and found that children in the ADHD group reported having significantly more symptoms of depression and anxiety and their parents reported that these children demonstrated significantly more internalizing and externalizing behaviors. In this study, children with ADHD did not differ from a pediatric psychiatric sample in their parents' report of internalizing (Mean T scores from Mother report: ADHD = 63.9; psychiatric = 63.5; controls = 58.3) and externalizing behaviors (Mean T scores from Mother report: ADHD = 69.0; psychiatric = 64.2; controls = 56.8). Father reports also followed this pattern. Children with ADHD also reported having more symptoms of depression (ADHD mean = 14.2; psychiatric = 14.3; controls = 7.4), and more anxiety (ADHD = .55; psychiatric = .52; controls = .39). In a five year longitudinal study, Biederman, Ball, Monuteaux, Surman, Johnson, and Zeitlin (2007) found that girls with

ADHD were at increased risk for eating disorders (16% versus 5%) and that girls with ADHD and an eating disorder reported higher rates of depression, anxiety, and disruptive behavior disorder than those with only ADHD.

ADHD also frequently co-occurs with learning disorders such as reading disorder (Hinshaw, 1992; Marzocchi, 2002). As a result of these comorbid disorders and executive deficits, children with ADHD often achieve at a level significantly below their peers and their own abilities (Hinshaw, 1992; Campbell, 2000; Mannuzza, 1997; Loe, and Feldman, 2007). Biederman et al. (2004) found that children with ADHD were at increased risk for grade retention and demonstrated reduced achievement even without evidence of learning disability. This finding was particularly pronounced in children with multiple deficits in executive functioning. White et al. (2005) found that adolescents with ADHD performed significantly below IQ-based expectations on tasks of numeric operations, word reading, spelling and written expression. Specifically, 18.2 percent of individuals in the ADHD sample had a standard deviation or greater discrepancy between IQ and numerical operations in contrast with only 7 percent of controls. The difference for word reading was 14.5% versus 6% and the differences for spelling and written expression were 19.4% versus 9% and 14.5% and 7%, respectively.

There is some evidence that children with ADHD are at increased risk for adolescent substance abuse relative to same-aged peers. For example, Molina and Pelham (2003) found in a longitudinal study that adolescents with ADHD were three times more likely to report using a non-marijuana illicit drug and more likely to report using multiple substances (10.6% versus 3%). They also reported more episodes of

drunkenness and smoking more cigarettes than adolescents in the comparison group. Researchers in this study found that inattention was predictive of these behaviors; however, there is some evidence that comorbid disorders such as oppositional defiant disorder may be more predictive of drug use among children with ADHD (August,Winters, Realmuto, Fahnhorst, Botzet, & Lee, 2006).

In addition to greater risk of psychiatric comorbidity or learning disability, children with ADHD are at increased risk for accidental injury, which is the leading cause of death and disability during childhood (Centers for Disease Control [CDC, 2005]). They are more likely to suffer poisoning, broken bones, head injuries, or suffer injuries which result in admission to an intensive care unit or disability (CDC, 2005). Discala, Lescohier, Barthel, & Guohua, 1998) Mitchell, Nañez, Wagner, and Kelly (2003) found that in a sample of children seen at the University of New Mexico Health Sciences Center for treatment of dog bites, twenty-nine percent had diagnoses of ADHD**.** In a longitudinal cohort study of 4119 children in Rochester, Minnesota, Leibson, Katusic, Barbaresi, Ransom, and O'Brien (2001) found that children with ADHD were more likely to suffer major injuries and were significantly more likely to be seen in an emergency room.

Although symptoms of hyperactivity have not been found to be significant predictors of injury (Davidson, Taylor, Sandberg, & Thorley, 1992; Schwebel, Tavares, Lucas, Bowling, & Hodgens, 2007), children with ADHD may demonstrate differences in cognition which increases their risk of injury. In a 1995 study, Farmer and Peterson showed 30 school-age boys (age 7 to 11 years) a ten minute video shown from the

perspective of the child (not pictured) who was walking home from school, thinking aloud, and commenting on things he saw along the way. The video included five risky situations, including going down a slide head first, crossing a street between two parked cars, and climbing a rickety fence to look down at a creek. Boys in the ADHD group and controls were equally able to identify risky situations; however the children in the ADHD group were more likely to report that they would engage in the behavior. Boys in the control group typically said they "never" would, while boys in the ADHD group most often reported that they would "probably not" engage in the behaviors. Also, boys in the ADHD group reported that they would be less upset about getting hurt and were more likely to report that a resulting injury would be mild and require only a trip to the doctor for a check up. Boys in the control group expected more severe consequences, such as having to go to the emergency room or hospital. They were also able to generate more strategies for prevention of injury than boys in the ADHD group. These findings suggest that, consistent with previous research which has indicated that children with ADHD are more impulsive, they are more tempted to take part in dangerous activities and less accurate when predicting the severity of consequences.

ADHD in Adolescents and Adults

Although children are rarely diagnosed with ADHD after age 10, the symptoms are not believed to disappear as children age. In fact, the symptoms of ADHD are believed to persist into adolescence and adulthood and change only in their presentation (Campbell, 2000; Goldstein, 1997; Murphy & Barkley, 1996; Barkley, 1998; Weiss & Hechtman, 1993; Biederman et al., 1993; Biederman et al., 1996a). Faraone, Biederman,

and Monuteaux (2002) examined a group of clinically-referred children and adolescents (total N = 811) with previous diagnoses of ADHD and found no differences in the number of ADHD symptoms; however childhood ADHD was associated with lower Global Assessment of Functioning (a measure of an individual's overall level of functioning at a particular time (APA, 2000)) scores and higher rates of comorbid psychiatric disorder. Nigg et al. (2005) found that adults with a childhood diagnosis of ADHD continued to demonstrate weaknesses in executive function which were related to persisting inattention and disorganization. Adults with ADHD had slower reaction times than normal controls and had increased incidence of lifetime alcohol and drug dependence and depressive disorder. Fischer, Barkley, Smallish, and Fletcher (2005), found that in adults with a childhood history of ADHD were impaired in comparison with normal controls on a continuous performance task, a letter cancellation task, and a card playing task. These participants demonstrated slower reaction times, more inhibition errors, and displayed more ADHD symptoms than controls even though they had significantly improved since childhood in their levels of hyperactivity. In a longitudinal study of 128 males, Biederman, Mick, and Faraone (2000) found that sixty percent of young adults who were diagnosed with ADHD in childhood no longer met criteria for diagnosis, but only 10 percent had fewer than five symptoms and Global Assessment of Functioning score greater than 60. In other words, ninety percent of boys with ADHD in this sample still had some symptoms at age eighteen to twenty years. It was also found that symptoms of inattention were less likely to remit than symptoms of hyperactivity or impulsivity. These findings suggests that, although symptoms of hyperactivity improve as

children mature, other symptoms of ADHD, including inattention and executive difficulties, persist into adulthood and continue to distinguish these individuals from their peers. Even if individuals with ADHD are able to successfully graduate high school and go on to college, they continue to experience difficulties. Weyandt and DuPaul (2006) reported in their review article that college students with ADHD were at increased risk of having academic difficulties, tended to have lower GPAs, were more likely to be placed on academic probation, and were less likely to graduate.

The impact of deficits associated with ADHD is not restricted to academic settings. In a study examining driving in young adults with ADHD by Barkley, Murphy, DuPaul, and Bush (2002), in comparison to controls, the participants in the ADHD group had more traffic citations, particularly for speeding, more traffic accidents in which they were at fault, more severe accidents, and more license suspensions. As a part of this study, participants also completed a computerized driving simulation on which the participants in the ADHD group made more errors. They also obtained lower scores on a test of driving rules and demonstrated more risk-taking behaviors while driving. Individuals with ADHD were also more likely to attribute their vehicular accidents to drug or alcohol use. These findings suggest that individuals with ADHD continue to be impulsive and demonstrate inattention to detail into adulthood, negatively impacting their ability to perform complex tasks such as driving. In addition to these difficulties within the community, there is a substantial body of evidence suggesting that the social problems that individuals with ADHD develop during childhood, such as difficulties forming and maintaining friendships and modulating emotional expression, may be some

of the most lasting and pervasive difficulties of the disorder and continue throughout development into adulthood. For example, Shaw-Zirt, Popali-Lehane, Chaplin, and Bergman (2005) found that in a college sample, individuals with ADHD reported having lower self-esteem and fewer social skills.

There is also evidence that increased prevalence of comorbidity continues into adulthood. In a study of young adults with childhood diagnoses of hyperactivity (ages 20 to 21), researchers found that they were at significantly higher risk for a variety of non-drug related psychiatric disorders (Fischer, Barkley, Smallish, & Fletcher, 2002). Specifically, in comparison to controls, they were at greater risk for meeting the diagnostic criteria for ADHD as adults (5% compared to 0% of controls), major depression (26% vs. 12%), borderline personality disorder (14% vs. 3%), and antisocial personality disorder (21% vs. 4%). Fifty-nine percent of formerly hyperactive children met the criteria for some disorder compared with 36% of the comparison group. The clinical sample was also significantly more likely to have utilized mental health services in adolescence or adulthood.

ADHD and Interpersonal Problems

Research indicates that children, adolescents, and adults with ADHD have significantly more interpersonal problems than those without the disorder. The diagnostic criteria for ADHD include interpersonal problems such as interrupting, intruding, and bullying peers and, in fact, it is often the effect of ADHD symptoms on parents and peers that lead children with the disorder to mental health professionals for assessment (APA, 2000). Children and adolescents with ADHD have families with more

conflict and higher divorce rates and have been found to have deficits in social interaction skills (Biederman et al., 1996b; Biederman, Faraone, & Chen, 1993). Also, relationship factors such as harsh treatment or inconsistent discipline by parents and difficulties with peers such as lack of social competence, unpopularity, or rejection have been found to predict externalizing disorders in childhood and behavior problems and psychopathology into adulthood (Sroufe, Duggal, Weinfield, & Carlson, 2000).

Disruptions in social competence in individuals with ADHD have been documented throughout development. In a study by De Wied, Goudena, and Matthys (2005), boys with disruptive behavior disorders such as ADHD and Oppositional Defiant Disorder (ODD) demonstrated deficits in situational and dispositional empathy, indicating that they are less able than peers to experience the emotions attributed to others in certain situations (situational) and this deficit is also a stable trait within this group (dispositional). In a 1995 study, Hinshaw found that boys with ADHD had poorer peer relationships than controls. In particular, a subgroup of children with high levels of aggression in addition to ADHD showed worse peer sociometric status, tended to have social goals of a sensation-seeking nature, and were observed to have increased levels of emotional reactivity. Hoza et al. (2005) examined 165 school aged children with ADHD 165 sex-matched classmates as part of the Multimodal Treatment Study of Children with ADHD, and found that children with ADHD were less preferred socially, less well liked, and more often in the rejected social status category.

Similarly, Nigg et al. (2002) examined relationships between symptoms of ADHD and the Big Five personality characteristics in an adult sample and found that inattention-

disorganization was associated with low conscientiousness and neuroticism, while hyperactivity and oppositional behaviors in childhood and adulthood were associated with low agreeableness. Conscientiousness refers to socially prescribed impulse control and is associated with school performance in children (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994) and job performance in adults (Hurtz & Donovan, 2000). Neuroticism refers to negative emotionality, anxiety, depression, and vulnerability to stress. Agreeableness is associated with trust, compliance, and altruism. Individuals low in agreeableness exhibit hostility, aggression, and bullying of others. These findings suggest that children with ADHD are prone to personality characteristics which are associated with interpersonal difficulties, anxiety, depression, and vulnerability to stress.

Maedgen and Carlson's (2000) analysis of emotion regulation in ADHD subtypes found deficits in social functioning in all subgroups, but demonstrated differences in the particular deficits within the ADHD subtypes. Children with ADHD – combined type were rated by parents and teachers as demonstrating more aggression when compared to children with ADHD – inattentive type and controls and displayed emotional dysregulation characterized by high intensity of positive and negative behavior. They also demonstrated increased symptoms of conduct disorder, psychotic behavior, motor excess and oppositional defiant disorder. These children were also rated by parents and teachers to be ignored more than controls and disliked more than controls and less preferred by peers. In contrast, children with ADHD - inattentive type were rated as socially passive and showed deficits on social knowledge on a self-report assessment. Children in both ADHD groups were reported to show increased anxiety and withdrawal symptoms.

Similarly, Diamantopoulou, Henricsson, and Rydell (2005) examined peer relations in a sample of 635 twelve-year-old children. Participants completed peer nominations and rated feelings of loneliness and self-perceptions of behavior conduct and self-worth. ADHD symptoms, conduct problems, internalizing symptoms, and low levels of prosocial activity were all significantly related to peer dislike. Children with symptoms of ADHD demonstrate reduced emotional regulation (a deficit in behavioral inhibition) and, as a result, may be more intense in the expression of positive and negative emotions. Children with attention problems are more likely to react inappropriately to frustration, demonstrate socially inappropriate behaviors, such as interrupting frequently or attempting to control peers, and be inattentive to social cues to appropriate behaviors; therefore, they may be chosen by peers for friendship or social interaction less frequently (Gentschel & McLaughlin, 2000; Greene et al., 1996).

Blachman and Hinshaw (2002) examined peer relationships among girls with and without ADHD who attended a 5-week summer camp. The participants, aged 6 to 12 years, were assessed during weeks 1, 3, and 5 of the camp and completed an interview where they were asked to nominate the three campers they liked the least and the three they liked the most. Friendship was assessed by checking for mutual nominations. Participants also completed a friendship qualities measure which assessed positive and negative relationship features. Positive features included companionship and help/guidance and examples of negative features were relational aggression and conflict. Children with ADHD had fewer mutual friends at every assessment point and were more likely than controls to report having no friends at all. They also had higher levels of

negative relationship features. In addition to differences found between controls and participants with ADHD, differences were found between the subtypes of ADHD. Girls with combined type ADHD had difficulty maintaining friends from the beginning to middle of camp while inattentive type ADHD participants had poorer relationship stability from middle to the end of camp. None of the girls in the inattentive group maintained more than one friendship during the course of the camp in comparison to 29 percent of controls. In summary, in a new setting with peers, girls with ADHD had more difficulty making and keeping friends, made fewer friends, and had lower quality friendships. Blachman and Hinshaw hypothesized that girls with ADHD had more difficulty because their symptoms – impulsivity, hyperactivity, inattention – impaired their ability to behave appropriately in friendships. For example, hyperactive girls may be more likely to impulsively aggress against peers and inattentive girls may be more likely to have difficulty maintaining the attention and contact required for sustaining friendships.

Some researchers are examining *social disability* as a characteristic feature of ADHD (Greene et al., 1996; Gentschel & McLaughlin, 2000). Greene et al. (1996) compared 140 children with ADHD to 120 controls on a variety of social functioning and psychopathology measures including the Child Behavior Checklist and Social Adjustment Inventory for Children and Adolescents (SAICA). Researchers found that children with ADHD had lower Global Assessment of Functioning (GAF) scores, reduced family cohesion, increased family conflict, and higher scores of delinquent behavior, aggressive behavior, social problems, and school problems in relation to peers.

Greene et al. (1996) also found that a subgroup of children in the ADHD group, including 22 percent of participants in the group, were "socially disabled," defined as having elevated levels of social deficits when compared to others with ADHD.

Most of the research on the social difficulties of individuals with ADHD has focused upon the problems children with ADHD have with their peers; however, some researchers have examined the interpersonal difficulties experienced by adults with attention problems. These studies tend to examine the relationships adults with attention problems have with romantic partners, coworkers, and their functioning within their communities. For example, adults with ADHD change jobs more frequently (Barkley, Murphy, & Kwasnik, 1996), have more legal problems (Barkley et al., 1996; Hansen et al., 1999), and have more mental health problems (Barkley et al., 1996; Mannuzza et al., 1991). Biederman et al. (1993) evaluated eighty-four adults with childhood and adult diagnoses of ADHD using a structured interview and a comprehensive battery of psychiatric, cognitive, and psychosocial assessments. They found that individuals with ADHD were more likely to be divorced or separated and had higher rates of antisocial symptoms. Murphy and Barkley (1996) found that adults with ADHD reported poorer psychosocial adjustment, more interpersonal problems, more job changes, multiple marriages, and school or job performance problems. Those in the ADHD group also tended to report poorer marital satisfaction, although this finding did not reach significance ($p = .08$). In summary, individuals with attention problems begin experiencing interpersonal problems in childhood and often continue experiencing them into adolescence and adulthood. Eakin, Minde, Hechtman, Ochs, Krane, Bouffard et al.

(2004) found that married adults with ADHD reported poorer overall marital satisfaction and, specifically, poorer satisfaction, consensus, affectional expression, and cohesion. They also indicated that their marriage was less healthy than controls and reported poorer general family functioning. Areas of functioning that were rated more poorly included: affective involvement, roles, communication and problem solving. When completing a semi-structured interview, 96% of the spouses of adults with ADHD stated that their partners' behavior interfered with their functioning in one or more domains, such as child rearing, communication and/or marital relationship. Ninety-two percent of the spouses felt they compensated in some way for their spouses' difficulties. In addition to relationship differences between individuals with ADHD and controls, research suggests that there are also differences between the ADHD subtypes. Canu and Carlson (2003) performed a study wherein college students with ADHD interacted with a female confederate and completed questionnaires regarding their dating and sexual history. Individuals with ADHD-combined type reported increased sexual drive and early dating experience, while ADHD inattentive type participants tended to be inexperienced and were perceived more negatively by female confederates.

The interpersonal difficulties experienced by individuals with ADHD may be related to the attention and impulse control deficits characteristic of the disorder. Individuals with ADHD perform more poorly on tasks of attention when compared to age-matched peers and this may make them prone to missing verbal and nonverbal cues that indicate appropriate behavior in a given situation. For example, Börger and van der Meere (2000) suggested that some of this variability may be due to the visual behavior of

children with ADHD on attention tasks. In their study of 17 children with ADHD and 15 controls, they found that children with ADHD looked away from the stimuli for a continuous performance task (CPT) more frequently and for greater duration than controls. However, this visual behavior only negatively impacted their performance on the CPT when presentation of stimuli occurred in an unpredictable manner. Although logic suggests that this finding would apply to adults as well, this study has not yet been replicated with adults. Also, although looking away did not significantly impact the performance of subjects on a CPT using letters, it may have an impact on a more social task.

Deficits in social competence are consistent with Barkley's theory of ADHD which identifies deficiencies in behavioral inhibition as a primary feature of the disorder (1997). According to Barkley, individuals with ADHD have interpersonal problems because, even with intact perceptual abilities, they are prone to have difficulty modulating their own emotional states, decreased frustration tolerance, and have an impaired ability to consider and implement appropriate behaviors. Individuals with ADHD, therefore, may be more likely to say things impulsively that are hurtful to others or struggle to maintain composure when displaying intense emotions may be socially inappropriate. Also, inattention may lead them to miss subtle cues to the emotions of others. These hypotheses are supported by recent research which has found that individuals with ADHD demonstrate higher levels of state and trait anger and have poorer forms of anger expression (Ramirez et al. 1997; Maedgen & Carlson, 2000), experience higher levels of emotional intensity (Rapport et al., 2002), demonstrate less

empathy (De Wied, Goudena, & Matthys, 2005) and have poorer quality friendships (Brook & Boaz, 2004; Diamantopoulou, Henricsson, & Rydell, 2005; Blachman & Hinshaw, 2002).

Another possible explanation for the interpersonal difficulties experienced by individuals with attention problems is a deficit in effective use of nonverbal social cues. Recent research has found that children and adults with ADHD perform more poorly than peers on tasks of affect recognition. Shapiro, Hughes, August, and Bloomquist (1993) found that young children with ADHD performed significantly worse than controls on tasks assessing facial affect recognition and matching prosody to content and facial expressions. Rapport, Friedman, Tzelepis, and van Voorhis (2002) also found that adults with ADHD are impaired on affect recognition tasks. In their study of 28 individuals with ADHD and 28 controls, individuals with ADHD performed significantly worse on affect recognition on adult and child versions of the DANVA (Diagnostic Analysis of Nonverbal Accuracy; a facial affect recognition task which includes faces expressing happy, sad, fearful, or angry emotions) and had worse overall accuracy and reaction times. These findings suggest that individuals with ADHD are less able than their peers to correctly identify the emotions being displayed by adults and children despite taking longer to examine their faces. Despite this poorer performance on affect recognition tasks, individuals with ADHD reported equal confidence in their accuracy as individuals without the disorder. In addition, individuals with ADHD scored significantly higher on a measure of affect intensity, suggesting that this group may have less control over the intensity of the emotions they experience and may be more prone to act out in stressful

situations. The researchers assert that the impaired performance of individuals with ADHD is not due to attention problems based on the longer reaction times of individuals with ADHD. They suggest that the longer reaction times indicated that individuals with ADHD did not perform impulsively; therefore, attention problems did not cause their deficits.

Facial Affect Recognition and Interpersonal Skills

The ability to recognize facial expressions accurately has been demonstrated to be an important part of interpersonal functioning. This ability helps individuals form relationships and attachment, provides cues to others' internal emotional states and intentions, and serves as interpersonal heuristics which allow us to make judgments about others (Ekman, 1999; Berry, 1991; Horstmann, 2003). Facial expressions provide cues as to the emotions that individuals are experiencing and interpreting these expressions correctly helps us to predict their behavior and respond accordingly (Buck, 1984; Ekman & Oster, 1982; Ekman, 1999). Consequently, individuals who incorrectly interpret nonverbal cues such as facial affect often experience difficulty in interpersonal relationships. Although all nonverbal cues can impact the way we view and are viewed by those we interact with, faces are believed to be a particularly powerful form of nonverbal communication (Knapp & Hall, 2006).

The ability to decode or interpret nonverbal cues correctly has been found to be related to a number of individual characteristics and outcomes (Knapp & Hall, 2006). Children who perform well on tasks assessing these abilities are rated as more popular, socially competent, and have less anxiety, aggression, depression, and emotional

disturbance. These children also are more likely to be perceived by their teachers as cognitively competent. Others rate adults who are better at accurately interpreting nonverbal cues as better adjusted, less hostile and less manipulative. These adults are also more interpersonally democratic, extraverted, demonstrate more empathy and are rated as more popular, warmer, and seen by others as interpersonally sensitive. In comparison with adults who are less accurate at decoding nonverbal cues (more proficient decoders) also report warmer, more satisfying relationships.

Blair and Coles (2000) studied facial affect recognition and interpersonal problems in a sample of fifty-five children between the ages of 11 and 14 years. They assessed facial affect recognition using Ekman and Friesen's 1976 picture series which includes examples of faces expressing happiness, surprise, fear, sadness, disgust, and anger. Interpersonal traits were assessed using the Psychopathy Screening Device (PSD), which includes scales assessing affective and interpersonal traits (ie. callous/unemotional factors) and impulsivity/conduct problems. Accuracy on the facial affect recognition tasks was inversely correlated with affective/interpersonal disturbance and impulsive/conduct problems. In other words, individuals who made errors on the affect recognition task were more likely to demonstrate disturbances in interpersonal interactions and report having conduct problems.

Carton, Kessler, and Pape (1999) examined the ability to interpret nonverbal social data and relationship well-being accurately in a sample of adults at a Midwestern university. Their sample included sixty students between 18 and 21 years of age. They assessed nonverbal decoding ability using the DANVA2 Adult Facial Expressions and

Adult Paralanguage versions. The Adult Facial Expressions version is composed of 24 photographs of male and female adults making happy, sad, angry, and fearful expressions of low or high intensity and the Adult Paralanguage version is composed of 24 recordings of an adult man and woman saying the sentence, "I am going out of the room now and I will be back later," to reflect the same emotions. Relationship well-being was assessed using the positive relations subscale of the Ryff Psychological Well-Being Scale (RPWS). This subscale includes 14 items to which participants indicate the degree to which it applies to them. Results indicated that participants who made errors in nonverbal decoding of facial affect and cues from vocal stimuli reported lower levels of relationship well-being.

Given their tendency to miss details in a variety of settings, it seems likely that individuals with attention problems may be more likely than others to miss or misinterpret nonverbal cues such as facial expressions. In fact, although most research in this area focuses on other disorders (i.e. alcoholism, schizophrenia, mental retardation, mania, etc., see Kohler, Turner, Gur & Gur, 2004 for a review) deficits in affect recognition among adults with attention deficits have already been demonstrated in previous research (Rapport et al., 2002). Also, there are some neuroimaging studies that may provide evidence for these deficits in individuals with ADHD. As noted previously, individuals with ADHD have been found to show structural brain variations when compared to controls. Specifically, the dorsolateral prefrontal cortex has been implicated in ADHD with children with ADHD having smaller volumes in this area of the brain (Seidman, Valera, & Makris, 2005; Mostofsky, Cooper, Kates, Denkla, & Kaufmann,

2002). Mah, Arnold, and Grafman (2004) found that adults with nonprogressive dorsolateral prefrontal cortex lesions had impaired social perception when they were asked to make inferences based upon nonverbal information such as facial expressions and body movements. While these findings do not conclusively associate attention problems and deficits on tasks assessing an individual's ability to interpret nonverbal social information, they do suggest an association and an area for continued study.

Hypotheses for the Present Study

In the present study, the researcher sought to corroborate the findings of Rapport, Friedman, Tzelepis and van Voorhis (2002) and demonstrate a relationship between ADHD symptoms and performance on affect recognition tasks. The researcher also sought to expand their study by examining the relationship between affect recognition ability and interpersonal skills as assessed by measures of interpersonal communication competence and life satisfaction. The null-hypotheses are as follows:

H1: Individuals with elevated ADHD symptoms perform as well as the comparison group on an affect recognition measure as demonstrated by similar accuracy (H1a) and reaction times (H1b).

H2: Individuals with elevated ADHD symptoms will perform as well as the comparison group on a non-affect facial recognition measure (control measure).

H3: Performance on the facial affect tasks (Affect Recognition and Age Labeling) will not demonstrate specificity for emotion.

H4: Life satisfaction in general and relationship satisfaction in particular will not be related to ADHD symptoms.

H5: Interpersonal communication competence will not be related to ADHD symptoms.

Method

Participants

Participants were recruited from the population of undergraduate students enrolled at George Mason University while enrolled in introductory psychology courses. These students were part of the university's research participation pool. A target sample size of 40 participants in each group was selected after a review of the literature indicated that studies examining ADHD symptoms have found group differences with total sample sizes as small as 30, with many studies having thirty of fewer participants in each group. Similarly, studies of affect recognition and interpersonal skills in adults tended to include twenty to thirty participants in each group. To be included in the study, participants must have been between the ages of 18 and 30. Individuals of both sexes and all ethnicities were recruited for participation. Specific inclusion criteria for group assignment are as follows:

ADHD Group. Participants were included in the ADHD group if they earned significant scores on the Conners' Adult ADHD Rating Scale Self-Report Screening Version (CAARS-S:SV) which was defined as a *T*-score of 60 or greater on either the DSM-IV Inattention Symptoms scale or DSM-IV Hyperactivity-Impulsive Symptoms scale or both. A clinical diagnosis of ADHD requires that symptoms be present prior to age seven (APA, 2000). Because this study examined the impact of current ADHD-

related symptoms in a non-clinical sample, reports of childhood symptoms were not required for inclusion in the ADHD group. Previous research has demonstrated the validity of adults' reports of their ADHD symptomatology (Downey, Stelson, Pomerleau, & Giordani, 1997). The ADHD group was divided into Clinical and Subclinical ADHD groups.

Clinical Group. Participants with clinically significant CAARS-S:SV *T*-scores of 65 or greater were included in "Clinical" datasets and utilized for additional analyses. Each these was based on one of the CAARS-S:SV indices (CAARS Inattention group, n = 15; Hyperactivity-Impulsivity, n = 8; Total, n = 14; ADHD Index, n = 10). All of these participants were later combined into a single dataset (n = 25).

Subclinical ADHD Group. Participants with CAARS-S:SV *T*-scores from 60 to 64 were included in the Subclinical ADHD group.

Comparison Group (CG). Participants with *T*-scores of 59 or below were included in the comparison group.

Matched Pairs group. As sex and age differences have been demonstrated in previous research for ADHD symptoms (APA, 2000; Drechsler, Brandeis, Földényi, Imhof, & Steinhausen, 2005) and affect recognition (Hampson, van Anders, & Mullin, 2006; Herba, Landau, Russell, Ecker, & Phillips, 2006; Issacowitz et al., 2007), researchers also created a matched-pairs dataset where all ADHD participants (N = 47) were compared with a reduced set of participants from the comparison group matched by sex and age (N = 47). Twelve males and 35 females from the comparison group were

randomly selected from the comparison group using a random number generator (randomization.com).

Regarding exclusion criteria, any reports of past or present neurological disorder preempted participation in the study. Participants were screened for history of a significant neurological disorder, such as head injury, stroke, or seizure disorder on the demographics questionnaire. As previous research has found affect recognition deficits among significantly depressed or anxious participants (Surguladze, Young, Senior, Brébion, Travis, & Phillips, 2004; Rossignol, Anselme, Vermeulen, Philippot, & Campanella, 2007; Rubinow & Post, 1992) individuals with significant signs of anxiety or depression were excluded. All candidates were administered the Beck Depression Inventory –II (BDI-II) and Beck Anxiety Inventory (BAI). Individuals with scores greater than 25 on the BDI-II or the BAI were excluded from the study. They were informed about their elevated scores via email and provided with contact information for the GMU Counseling Center and the GMU Psychological Clinic.

During five months of data collection, 196 volunteers were recruited as potential study participants. Forty-seven met criteria for inclusion in the ADHD group and 81 were selected for inclusion in the comparison group. Twenty participants were excluded due to history of head injury, seizure, or other neurological event. Twenty-six were excluded due to scores greater than 25 on the BDI-II, BAI, or both. Twenty-two participants were excluded due to some combination of these factors or other confounding factors, such as a recent car accident with chronic pain or reported suicidal

tendencies, which may have impacted their performance. The 196 students who completed the research protocol received course credit.

Instruments

The Affect Recognition Task

The Affect Recognition task consisted of 140 photographs that were selected from the NimStim Set of Facial Expressions (Tottenham et al., submitted for publication; www.macbrain.org/faces). Faces were presented centered on a portable computer screen in a randomized order for each participant. Each picture was 500 X 650 pixels in size. Facial stimuli were presented using Superlab 4.0, (Cedrus, 2006) a stimulus presentation software designed for use in research. Each participant was given the following instruction prior to completing the Affect Recognition Task: "Photographs of faces will appear on the screen one at a time. For each one, indicate the emotion that is displayed by the person, by pressing its button below. Indicate if the person is showing happy, sad, angry, surprised, fear, disgust, or neutral. Respond as quickly and as accurately as you can." Next, participants completed three practice trials and were given the opportunity to ask questions.

The *NimStim Set of Facial Expressions* is a set of 672 photographed images of faces posed by 43 professional actors in New York City. Actors were between the ages of 21 and 30 years when photographed. Actors are from different ethnic groups including 10 African-American, six Asian American, 25 European American, and two Latino and represent both sexes (males $n = 25$, females $n = 18$). The actors, with contemporary hairstyles and makeup, were instructed to pose eight different expressions

(happy, sad, angry, fearful, surprised, disgusted, neutral, and calm). Each actor posed 16 expressions, with half of them with open and the other half with closed mouth versions for every expression except surprise (open expression only). Each actor posed three versions of happy – open mouth, closed mouth, and exuberant (high arousal).

The NimStim Set of Facial Expressions has shown good inter-rater agreement with a mean kappa of .79 for all stimuli and expressions displayed by the actors (SD = .17); median of.83 and overall proportion correct of .82 (*SD* = 0.20; median = .88; Tottenham et al., submitted for publication). Concordance across actors was also good with a mean proportion correct ranging from .81 to .97 for pictures with κ.ranging from .80 to 1.0 and mean proportion correct ranging from .66 to .84 for pictures with κ.ranging from 59 to .80 (Tottenham et al., submitted for publication). Consistent with other facial affect stimulus sets happy is most frequently recognized accurately (i.e., Age Labeling Task and Pictures of Facial Affect; see, Rojahn, Gerhards, Matlock, & Kroeger, 2000; Rojahn et al., 2002; Yang et al., 2002). This stimulus set also demonstrates good test-retest reliability with mean correlation of .77 between administrations (*SD* = .23; median = .85).

The subset of pictures used in the present study was selected using the following procedure. Pictures were sorted by emotion so that 20 pictures could be selected from the fear, happy, sad, disgust, anger, surprised, and neutral groups (*N* = 120). Pictures in each set were sorted into three groups by their validity score .51 to .60, .61-.70, and .71 to .80. For example, as validity score of .61 would indicate that 61 percent of individuals in the validation study correctly identified the expressed emotion. The goal was to select

pictures with an average validity score in the low 70s to allow for variability in participant scores and to avoid ceiling and floor effects. Five pictures were randomly selected from each emotion group using a random number generator (randomization.com) from the .61 to .70 group and four were randomly selected from the .71 to .80 group. Pictures were selected randomly until 20 had been selected for each emotion and no emotion group had two pictures of the same actor. The final set had a mean accuracy rating of .71 (range = .61 - .80) included 42 models, and 51 pictures of females (males $N = 69$).

The Age Labeling (Control) Task

The Age Labeling Task consisted of 25 black and white photographs of adults ranging from in age from their teens to their seventies. Photographs were taken by a professional photographer with hair, background, and clothing cropped out of the picture so that only the face is visible. The items were selected from the *Facial Discrimination Task (FDT; Erwin et al., 1992), a set of* 181 photographs. The faces displayed happy, sad, or neutral expressions. Participants had to rate each photograph as belonging to one of five age groups: twenties (20 to 29), thirties (30 to 39), forties (40 to 49), fifties (50 to 59) and sixty and greater. Each participant was given the following instruction: "For this task, pictures of faces will appear on the screen one at a time. For each one, indicate the age of the person pictured by pressing the buttons below. Indicate if the person is in their 20s, 30s, 40s, 50s, or 60 or greater. Respond as quickly and as accurately as you can." Participants completed three practice trials and were given the opportunity to ask questions before beginning the task.

The FDT has been used as an affect recognition task or an age labeling task in a variety of clinical and normal populations (Rojahn, Gerhards, Matlock, & Kroeger, 2000; Schneider, Gur, & Gur, 1995). The FDT has demonstrated good validity with 70 to 80% of normal participants correctly identifying the depicted emotion and retest reliabilities ranging from .52 to 1.0. The age task also reported good validity and an average retest reliability of 63%. Using validity and reliability data for each picture in the FDT set, researchers used a multi-step strategy to select pictures with a goal of creating a set with a mean accuracy rating (i.e. percentage of participants to identify correctly the age of the model) of approximately 70%. First, all pictures depicting a neutral facial expression were selected and all pictures depicting happy or sad facial expressions were excluded. Second, researchers selected pictures with mean accuracy ratings which ranged from 50 to 90%. This range was selected to produce an item set which varied in difficulty, but with the total set of items possessing an average accuracy rating greater than 50%. The pictures belonging to each group were each assigned a number. Finally, all pictures with re-test reliabilities less than .40 were excluded. The resulting set had 25 items and a mean accuracy rating of 71.1%. Facial stimuli were presented using Superlab 4.0, (Cedrus, 2006) a stimulus presentation software designed for use in research. Faces were presented centered on the screen and each is 500 X 650 pixels in size.

The *Extended Satisfaction with Life Scale (ESWLS;* Allison, Alfonso, & Dunn, 1991) is a 25-item scale designed to assess a respondent's satisfaction in five areas: general life, social life, sexual life, relationship, and self. It is composed of 25 statements which respondents indicate their level of agreement on a scale of 1 to 7, with 1 =

"strongly disagree" and 7 = "strongly agree." The ESWLS was developed by expanding the original Satisfaction with Life Scale (SWLS) to examine multiple areas of life. The total score is obtained by summing the item scores and higher scores indicate a greater level of life satisfaction.

The ESWLS has good reliability with coefficient alphas ranging from .85 to .97 for the five subscales. The reliability for the 25 items combined ranged from .94. to .96. Factor analysis supported the hypothesized structure of the scale with the five factor model accounting for 75.9 to 81.2% of the variance (Allison et al., 1991).

The *Interpersonal Communication Competence Scale (ICC;* Rubin & Martin, 1994) is a 30-item measure of adult interpersonal communication competence which is a person's ability to manage interpersonal relationships in communication settings. It includes items to assess 10 interpersonal communication skills – self-disclosure, empathy, social relaxation, assertiveness, interaction management, altercentrism, expressiveness, supportiveness, immediacy, and environmental control. Self-disclosure is the ability to open up or reveal one's personality elements. Empathy is the ability to feel what another is feeling. Social relaxation is a lack of anxiety in everyday social situations. Assertiveness refers to one's ability to stand up for his or her rights without infringing upon the rights of others. Interaction management is the ability to adhere to the culturally approved rituals or rules of communication. Altercentrism refers to an interest in others and their point of view and the ability to adjust to fit their needs. Expressiveness is the ability to communicate one's feelings through nonverbal behaviors. Supportiveness is the degree to which one is able to be supportive in communication

through descriptive, nonjudgmental, and empathic responses. Immediacy is the expression of openness and approachability. Environmental control refers to one's ability to achieve communication goals and solve conflicts successfully.

For each item, the respondent is asked to rank how well each statement reflects their typical way of communicating with others by giving it a score from 1 to 5, with 1 = "If you almost never behave this way" and 5 = "If you almost always interact in this way." The total score is computed by summing the item scores and higher scores indicate greater interpersonal communication competence. Each communication skill is assessed with three items, most of which were developed via examination of existing measures of communication skills. The ICC has good internal reliability of .86 and good validity when correlated with other measures of communication skills (Rubin & Martin, 1994).

Conners' Adult ADHD Rating Scale – Self Report: Screening Version (CAARS-S:SV; Conners, Erhardt, & Sparrow, 1999) is a self-report instrument designed to assess ADHD symptoms and behaviors in adults. The instrument was designed to assess these symptoms across multiple, clinically-relevant domains, to discriminate between clinical and non-clinical groups, and to address symptoms linked to the diagnostic criteria in the DSM-IV. The screening version has 30 items and produces three DSM-IV-linked indices and an ADHD index. It also includes an inconsistency index which is designed to identify random or careless responding. The screening version takes 10 minutes to administer. Higher scores indicate more symptoms and *T*-scores greater than 65 indicate clinically significant symptoms.

The CAARS-S:SV was normed on 2,000 nationally representative adults of varying ages and ethnicities. Items consist of simple statements which require only a fourth grade reading level and are rated by the respondents on a 4-point Likert as to how much they apply to them (0= Not at all never, 1= Just a little, once in a while, 2 = Pretty much, often, 3= Very much, very frequently). The CAARS-S:SV has good reliability and with internal consistency coefficients ranging from .66 to .83 for the adult sample and .64 to .86 for 18 to 29 year olds and test-retest reliability of .90 for the ADHD Index. The CAARS-S:SV also has good factor validity as evidenced by confirmatory factor analysis and a discriminant validity study which indicates that the CAARS-S:SV correctly classifies individuals with ADHD 85% of the time (Conners, Erhardt, & Sparrow, 1999).

The Beck Anxiety Inventory (*BAI;* Beck & Steer, 1993) is a 21-item scale to assess the level of self-reported anxiety. The BAI was designed for adults ages 17 to 80 and is composed of items each describing a common symptom of anxiety. The respondent is asked to rate how much he or she has been bothered by each symptom in the previous week on a 4 point scale [0 = "Not at all"; 1 = "Mildly, didn't bother me much"; 2 = "Moderately, it was very unpleasant, but I could stand it"; 3 = "Severely, I could barely stand it."]. The total score is obtained by summing the item scores and can range from 0 to 63. Higher scores indicate a higher level of anxiety.

The BAI has strong reliability with internal consistencies ranging from .92 to .94 for adults and test-retest reliability of .75 after one week (Beck & Steer, 1993). Also, the BAI has good concurrent validity with correlations in the .50s with other commonly used

anxiety scales such as the State-Trait Anxiety Inventory and content validities of .85 to .93 when compared with the DSM-III-R diagnostic criteria. (Beck & Steer, 1993). The BAI can be administered in five to ten minutes.

The Beck Depression Inventory – Second Edition (BDI-II; Beck, Steer, & Brown, 1996*)* is a 21-item self-report measure designed to assess the presence and level of depressive symptoms. The BDI-II includes items describing symptoms common to depression including symptoms of anhedonia, irritability, hopelessness, changes in sleep, appetite, libido, and cognitive symptoms such as lack of concentration. Each item includes a group of four statements which each statement assigned a score of 0 to 3. The respondent is asked to consider each statement and choose the one that best describes how he or she has felt in the past two weeks. The total score is computed by summing the item scores. Higher scores indicate a greater level of depression.

Beck, Steer, and Brown (1996) found that the BDI-II has good psychometric properties. The BDI-II has good reliability with construct validity of .80 and it is able to distinguish depressed and non-depressed respondents. Coefficient alphas range from .92 to .93 and test retest reliability after a one week delay was .93. The BDI-II was designed to conform to the DSM-IV diagnostic criteria. The BDI-II is appropriate for use in adults and adolescents over the age of 13 and can be completed in 5 to 10 minutes.

Participants also completed a demographic questionnaire which recorded their age, year of study, ethnicity, marital status, and screened for exclusionary criteria. Data was also collected on the number of cigarettes smoked and caffeinated beverages consumed in the 24 hours and 2 hours prior to participation as these may have affected

participants' level of arousal and their current living situation (alone, roommate, family, partner, or spouse), relationship status, duration of relationship, and previous or current psychological diagnoses.

Procedures, Settings, and Apparatus

Participants were recruited through Experimetrix, an online experiment registration system used at GMU. Students access Experimetrix through a website and can search and sign up for experiments. Participants were undergraduate students currently enrolled at GMU. The online description solicited males and females ages 18 to 30 with and without a history of attention problems. Participants that contacted the researchers and indicated interest were screened for a history of psychological disorder, head injury, neurological disorder, and addiction.

On the date of participation, participants were seen in a small, quiet room on GMU's campus and near the psychology department of GMU in Fairfax, Virginia. Informed consent was obtained and participants had an opportunity to ask any questions about the requirements of participation. Each participant was then administered the dependent measures in a randomized order. Participants were compensated with two course credits if they were currently enrolled in a course which accepted credits for research participation.

Participants completed self-report measures (BAI, BDI-II, CAARS-S:SV, ESWLS, ICC) in groups of four with questionnaires presented in a randomized order. Each participant completed the computerized facial affect task and facial age labeling task in a separate part of the room set apart from any other participants. The subset of

facial affect stimuli (Affect Recognition Task) and age task stimuli (Age Labeling Task) was presented to participants via Superlab 4.0 on a Sony VAIO VGN-SZ230P notebook computer with a 14 inch widescreen monitor. Pictures were shown centered on the screen.

For the facial affect task, participants were asked to respond to each pictured stimulus by identifying the emotion displayed by the face in the picture by using a Cedrus RB-730 model response pad. The response pad is 9 ½ inches wide 6 ¼ inches deep and 7/8 inches high. It is light gray in color and has seven buttons on the top third approximately one inch from the top edge. Each button is ½ inch by ¾ inch. This model was selected because its buttons are separate from the keyboard and this would prevent any confusion when responding. The RB-730 response pad offers 1 millisecond reaction time resolution in comparison to the average PC resolution of 20-35 milliseconds (http://www.cedrus.com/). For the affect recognition task, the buttons were labeled from left to right (participants' view) as follows: happy, sad, anger, surprise, fear, disgust, neutral. For the age task, buttons 1 through 5 (starting from the participants' left) were labeled as follows: 20s, 30s, 40s, 50s, 60+. This order was identical for every participant. The pad was placed 1 inch in front of the keyboard for each participant. Participants initiated the facial affect and age tasks by pressing a start button, and then each slide remained on the screen until the participant responded by clicking on a response. Slides faded from one to the next with a blank black screen presented during the change interval. Three practice trials were completed prior to the start of the experimental task. Response time and accuracy were recorded for each trial. After completion of research

tasks, participants were debriefed and received course credit (if applicable) for their participation.

Data Analysis

Data were analyzed using SPSS (Statistical Package for Social Scientists). Prior to testing the hypotheses, data were scrutinized for outliers, errors, and sex differences. Correlations were computed between the CAARS-S:SV and the performance on the Affect Recognition Task and MANOVAs were performed to examine group differences between the ADHD and comparison groups on the Affect Recognition Task. Initially, the researcher ran a MANOVA to examine total accuracy and reaction time. Next, the researcher ran MANOVAs to examine group differences for accuracy on all specific facial expressions (H1) and reaction times for all facial expressions (H1b). The null hypothesis stated that individuals with elevated symptoms of ADHD would perform as well as the comparison group on an affect recognition measure as demonstrated by similar accuracy (H1a) and reaction times (H1b). An ANOVA was performed to examine group differences on the Age Labeling (control) Task. The null hypothesis was that there would be no group difference (H2). A MANOVA was run to examine the emotion specificity of performance on the facial tasks, with the total accuracy score for each as dependent variables. The null hypothesis was that there would be no emotion specificity (H3). Correlations were computed between scores on the CAARS-S:SV and ESWLS (H4). The null hypothesis was that life satisfaction ratings would not be correlated with scores on the CAARS-S:SV. Correlations were run to examine

relationships between the CAARS-S:SV and interpersonal communication competence scores (ICC) (H5). Bonferroni corrections were performed where appropriate. The null hypothesis predicted that there would be no significant relationship. ANOVAs and correlations were also run to examine group differences and relationships in self-reported symptoms of depression and anxiety.

Results

Demographic Data

Before testing the study's hypotheses, the researcher completed exploratory data analyses to examine outliers and check the data for entry errors. If one outlier, defined as a score two standard deviations above or below the group mean, was detected, every data point for that participant was checked for accuracy. The data of 32 participants (approximately 34% of the total set, and 2,688 data entries) were checked for errors. The vast majority of outliers were for the percent correct or reaction times for the Affect Recognition Task. As they appeared to be dispersed equally between the ADHD and comparison group, these were believed to be natural variations in the data. There were three data entry errors (0.001%) of the total number of data entries, which were corrected.

Next, descriptive statistics were computed for the total dataset, and the ADHD and comparison groups. Participants in the ADHD group ranged from 18 to 29 years in age and from 18 to 30 years in the comparison group. The mean age for participants in the ADHD group was 19.43 and 19.35 in the comparison group with standard deviations of 1.92 and 2.19, respectively. An ANOVA indicated that this group difference was not significant (F [1, 126] = .09, p = .76). The ADHD group included 12 males and 35 females (25.5% male) and the comparison group included 13 males and 68 females (16% male; see Table 1). This difference was not statistically significant, but approached

significance (F [1, 126] = 2.23, p = .13). Given this finding and the large number of female participants which was expected given the greater percentage of female undergraduate psychology students at GMU and other universities, a separate dataset was created where participants were paired by sex, age, and race.

The matched-pairs dataset included 47 participants in each group. Analyses were performed using the original full dataset and the matched-pairs dataset. Both the comparison and ADHD groups were multiethnic (see Table 2b). The ADHD group was 63.8% European American, 12.8% Asian, 6.4% African-American, 6.4% Hispanic, 4.3% African, and 6.4% of ADHD participants identified multiple ethnicities or "other." The comparison group was 46.9% European American, 22.2% Asian, 11.1% Hispanic, 8.6% African American, 2.5% Middle Eastern, 1.2% African, and 7.4% of participants in the comparison group identified multiple ethnicities or "other." The majority of participants were freshman (53.2% of ADHD participants [n = 25] and 50.6% of individuals in the comparison group [n = 41]). The AP group had 19.1% sophomores, 14.9% juniors, and 12.8% seniors. The CG group was 25.9% sophomores, 14.8% juniors, and 8.6% seniors.

Finally, descriptives were calculated separately for Clinical participants (n = 25, see Table 2c). This group, composed of participants with CAARS-S:SV T-scores in the clinical range (equal to or greater to 65), was similar to other groups in the study in that it was mostly female (72% versus 28% male) and composed primarily of freshmen (48% freshmen). Participants in the Clinical group were less ethnically diverse and were 60% European-American, 12% African-American, 0.08% Asian, 0.08% African, 0.08% Hispanic, and 0.04% of participants describing themselves as belonging to multiple

ethnic groups or "other." Descriptives were also computed for Clinical participants in the datasets selected by individual CAARS-S:SV indices (see Table 2c).

Groups were similar in their relationship status as 48.1% of those in the comparison group and 46.8% of ADHD group participants reported being in a relationship at the time of the study. No participants in the comparison group reported currently taking medication for attention problems, while 8.5% of participants in the ADHD group ($N = 4$) reported doing so. Medications included Concerta and Adderall.

Table 1.
Participant Ages by Group

		ADHD Group ($n = 47$)	Comparison Group ($n = 81$)	Total ($N = 128$)
Age	Mean	19.43	19.35	19.39
	SD	2.20	1.92	2.01
	Min	18	18	18
	Max	29	30	30

Table 2a.
Participant Demographics and Sex, Year, and Ethnicity Frequencies for Total Sample

		ADHD Group (n = 47)	Comparison Group (n = 81)	Total (N = 128)
Sex	Males	12	13	26
	Females	35	63	103
Year	Freshmen	25	41	66
	Sophomores	9	21	31
	Juniors	7	12	19
	Seniors	6	7	13
Ethnicity	African-American	3	7	10
	Caucasian	30	38	68
	Asian	6	18	25
	Middle Eastern	0	2	2
	African	2	1	3
	Hispanic	3	9	12
	Other	3	6	9

Participants in the ADHD group were more likely to report having a previous diagnosis of a psychological disorder (21.3% versus 7.4%; see Table 3 and Figure 1) and more likely to report a current psychological disorder for which they were receiving treatment (10.6% versus 1.2%). The past diagnoses reported were learning disabilities, ADHD, depression, and anxiety and current diagnoses included learning disability, ADHD, or some combination of disorders. Participants in the comparison group were only slightly more likely to be in a romantic relationship at the time of the study (46.8% of participants in the ADHD group and 48.1% of those in the comparison group reported a current relationship; see Table 4); however the participants in the comparison group reported longer relationships (ADHD mean duration = 8.6 months; comparison group =

11.3 months). Those in the comparison group were most likely to be living with family (44.4%) while most ADHD group participants were more often residing with roommates on- or off-campus (46.8%; see Figure 2). Next, the researcher ran ANOVAs and created correlations matrices for all dependent measures using the complete dataset (N = 128).

Table 2b.
Participant Demographics and Sex, Year, and Ethnicity Frequencies for Matched Pairs Dataset

		ADHD Group (n = 47)	Comparison Group (n = 47)	Total (n = 94)
Age	Mean	19.43	19.36	19.39
	SD	2.20	1.98	2.08
	Min	18	18	18
	Max	29	30	30
Frequencies:				
Sex	Males	12	12	24
	Females	35	35	70
Year	Freshmen	25	20	45
	Sophomores	9	13	22
	Juniors	7	7	14
	Seniors	6	7	13
Ethnicity	African-American	3	3	6
	European American	30	21	51
	Asian	6	12	18
	Middle Eastern	0	2	2
	African	2	1	3
	Hispanic	3	5	8
	Other	3	3	6

Table 2c.

Participant Demographics and Sex, Year, and Ethnicity Frequencies for Clinical Groups

		CAARS Inattention (n = 15)	CAARS Hyperactive/ Impulsive (n = 8)	CAARS Total (n = 14)	CAARS ADHD Index (n = 10)	All Clinical (n = 25)
Age	Mean	19.07	19.25	19.21	18.70	19.28
	SD	1.33	2.05	1.76	1.06	1.57
	Min	18	18	18	18	18
	Max	22	24	24	21	24
Frequencies:						
Sex	Males	3	2	5	0	7
	Females	12	6	9	10	18
Year	Freshmen	8	5	8	7	12
	Sophomores	4	1	2	0	7
	Juniors	2	1	1	2	3
	Seniors	1	1	3	1	3
Ethnicity	African-American	3	1	2	1	3
	European American	8	7	10	8	15
	Asian	0	0	0	1	2
	Middle Eastern	0	0	0	0	0
	African	2	0	0	0	2
	Hispanic	1	0	2	0	2
	Other	1	0	0	0	1

Table 3.
History and Current Psychological Diagnoses

		ADHD Group (n = 47)	Comparison Group (n = 81)	Total (N = 128)
Previous	None	37	75	113
	Depression	1	0	1
	Anxiety	0	3	3
	ADHD	3	0	3
	Learning Disability	2	2	4
	Multiple	4	0	4
	Other	0	1	1
Current	None	42	80	123
	ADHD	1	0	1
	Learning Disability	0	1	1
	Multiple	4	0	4

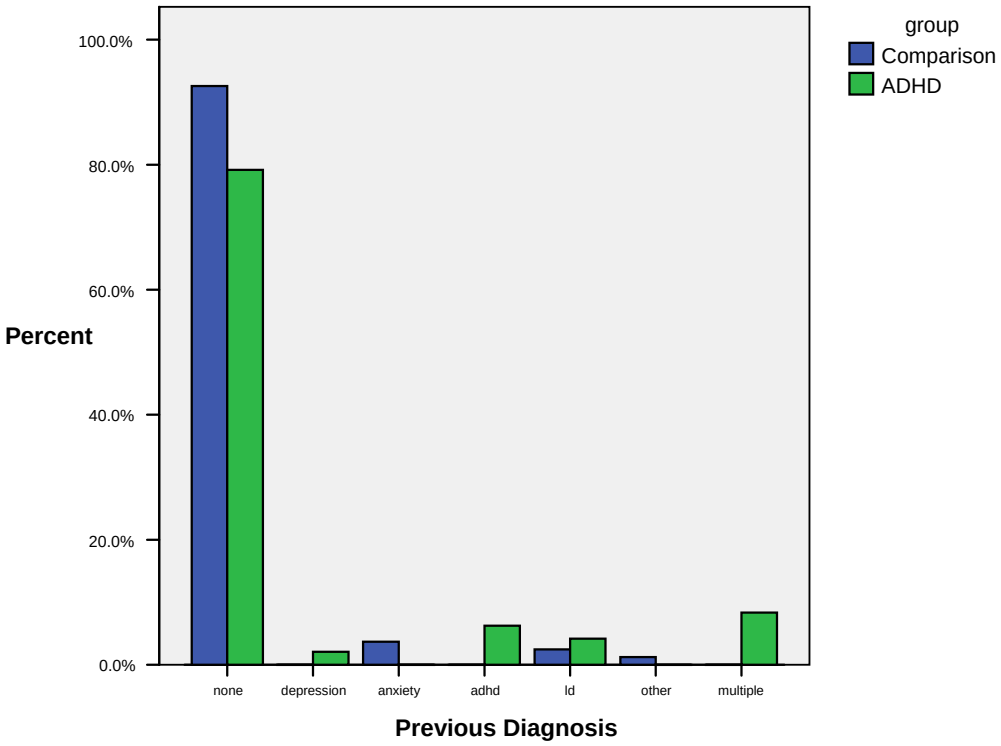

Figure 1.
History of Psychological Diagnosis

Table 4.
Relationship Characteristics and Living Arrangements

		ADHD Group (n = 47)	Comparison Group (n = 81)	Total (N = 128)
Relationship	No	25 (53.2%)	42 (51.9%)	67 (51.9%)
	Yes	22 (46.8%	39 (48.1%)	61 (48.1)
Duration Relationship	Mean	8.64	11.3	10.43
	SD	12.63	18.14	16.31
	Min	0	0	0
	Max	60	96	96
Living Arrangement	Alone	2	5	7
	Family	14	36	51
	Romantic Partner	5	1	6
	Roommate	22	33	55
	Other	4	6	10

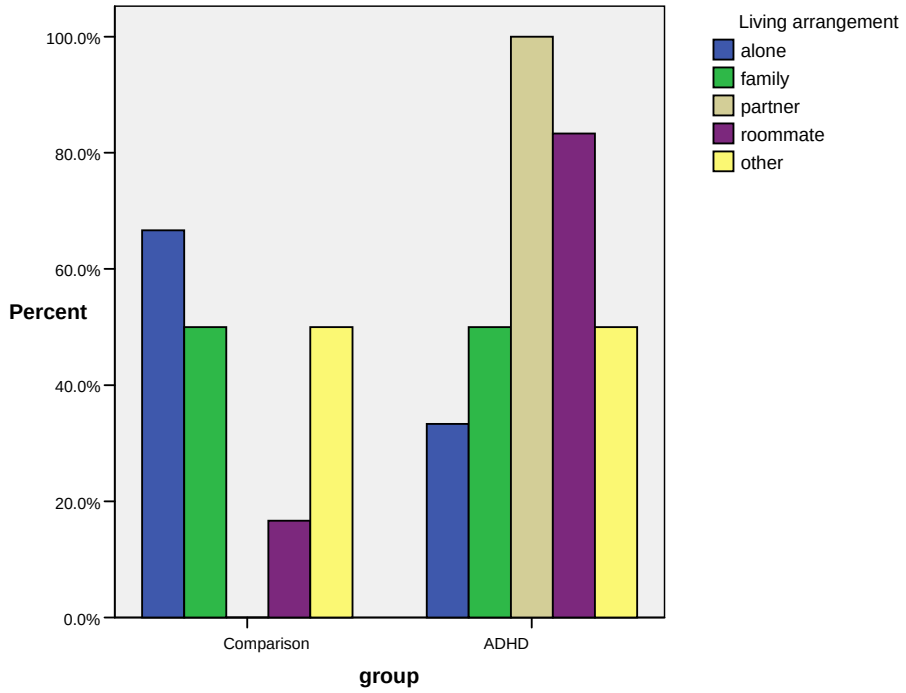

Figure 2.
Participant Living Arrangements

Hypothesis 1a – Affect Recognition Task Accuracy

Initially, correlations were run to examine relationships between participants' accuracy on the Affect Recognition task (specific facial expressions and total score; see Table 5) and other dependent measures. A Bonferroni correction was performed for these correlations so that as each facial expression was correlated with the four CAARS-S:SV indices, $p = .05 \times ¼ = .0125$. There was no significant correlation between accuracy on the Affect Recognition Task and life satisfaction. Correct identification of sad faces was positively correlated with relationship duration ($p < .0125$) and the correlation between identification of fearful faces and relationship duration neared significance ($p = .013$). Correlations were run to examine relationships between participants' accuracy on the Affect Recognition task and self-rated Interpersonal Communication Competence. A Bonferroni correction was performed for these correlations so that as each facial expression was correlated with the eleven ICC subscales, $p = .05 \times 1/11 = .0045$. Total accuracy score on the Affect Recognition Task was correlated with social relaxation $p < .0045$. None of the ICC subscales were significantly correlated with the Affect Recognition Task; however, the correlation between ICC social relaxation and the total accuracy for the Affect Recognition Task neared significance ($p = .006$; see Table 6). Correlations were run to examine the relationships between participants' accuracy on the Affect Recognition Task and their accuracy and reaction times on the control task (Bonferroni correction: $p = .05 \times ½ = .025$; $p = .01 \times ½ = .005$). Correct identification of fearful ($p < .005$) and sad faces ($p < .025$) as well as the total accuracy score ($p < .025$) were significantly correlated with the reaction times on the control task and total

accuracy on the control task was significantly correlated with total accuracy on the Affect Recognition Task ($p < .025$). Participants' total accuracy on the Affect Recognition Task was not significantly correlated with the CAARS-S:SV indices (H1a; see Table 7).

Next, the researcher ran MANOVAs to examine group differences on the accuracy scores of the seven emotion categories of the Affect Recognition Task. The multivariate effect was not significant (Wilks' $\lambda = .99$, F [7, 141] = 0.22, $p = .98$; see Table 7); thus, the null hypothesis was supported.

MANOVAs examining data for sex differences indicated that there was no multivariate difference between males and females for accuracy on the Affect Recognition Task (Wilks' $\lambda = .04$, F [7, 141] = .84, $p = .55$).

Table 5.

Pearson Correlations for Affect Recognition Accuracy, CAARS-S:SV, ESWLS, BDI-II, and BAI

	Facial Expressions							
	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise	Total
CAARS:S-SV Indices								
Inattention	-.01	.18	.05	-.05	.11	-.06	-.01	.08
Hyperactivity/ Impulsivity	-.14	.06	.01	-.03	.03	-.13	-.07	-.12
Total	-.06	-.04	-.01	-.03	-.04	-.12	-.02	-.06
ADHD Index	-.02	.19	-.03	-.07	.07	-.12	-.06	-.01
ESWLS Subscales								
General	-.05	.02	-.05	-.06	.14	-.16	.21	-.03
Social	-.03	.05	.09	-.13	.07	-.17	.01	-.04
Sex	-.07	.07	.02	-.15	.06	-.04	.13	-.01
Relationship	-.04	.05	-.01	-.11	-.16	.17	.13	.05
Self	.00	.03	-.02	-.02	.15	-.10	.15	.03
Total	-.06	.07	.01	-.15	.02	-.03	.18	.03
BDI-II	-.00	.19	.05	-.07	-.04	-.03	-.05	.05
BAI	.09	-.01	-.05	-.03	.01	-.04	-.01	-.02

Table 6.

Pearson Correlations for Affect Recognition Accuracy, ICC, and FDT Age Labeling Task

	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise	Total
ICC Subscales								
Total	.14	.08	-.00	.14	.02	-.04	.06	.12
Disclosure	.10	.05	-.04	-.06	-.05	-.08	.08	.04
Empathy	.02	.01	-.07	-.01	-.01	-.12	-.05	-.07
Social Relaxation	.22	.06	.06	.07	-.03	.07	.19	.24
Assertiveness	.04	.10	.08	.00	-.01	.00	.08	.11
Altercentrism	.00	.08	-.02	-.10	-.07	-.03	.03	-.03
Interaction Management	.01	-.01	.05	-.05	.02	.02	.12	.04
Expressiveness	.09	.05	-.02	.13	-.04	-.09	.08	.04
Supportiveness	.00	.03	-.04	.07	.14	-.08	.03	.03
Immediacy	.06	.03	.06	.09	.05	-.10	-.03	.05
Environmental Control	.10	.07	.04	.11	-.12	-.01	.03	.07
FDT								
Accuracy	.10	.04	.08	.06	.15	.08	.08	.23*
Reaction Time	.05	-.07	.28**	-.01	.01	.20*	-.06	.21*

**p <.025; **p <.005*

Table 7.
Affect Recognition Task Accuracy

	ADHD (n = 47)		Matched Comparison Group (n = 47)			
	Mean	*SD*	Mean	*SD*	*F*	*p*
Angry	.60	.19	.61	.19	.03	.87
Disgust	.62	.18	.61	.17	.09	.77
Fear	.44	.18	.42	.23	.34	.56
Happy	.87	.14	.86	.13	.33	.57
Neutral	.88	.11	.89	.11	.10	.75
Sad	.51	.22	.48	.21	.39	.54
Surprise	.71	.15	.73	.12	.30	.59
Total	.66	.05	.66	.07	.26	.61

MANOVAs were rerun with the matched-pairs set (n = 94) and found no significant group differences on the affect recognition measure (Wilks' λ = .98, F [7, 86] = 0.23, p = .98). Next, the researcher considered the possibility that any differences might be more apparent if the participants in the sample with more extreme scores were examined. The researcher created a new dataset in which participants whose CAARS-S:SV *T*-scores were in the top or bottom 25% of the sample were selected. However, the top 25% of the sample still included participants within the normal range and did not differ from the original analyses significantly. Next, the researcher created datasets which only included participants with CAARS-S:SV *T*-scores greater than 65 which would place them in the clinical range, (referred to as the "Clinical datasets," and compared these clinical participants with the comparison group (*T*-scores 59 or lower) and Subclinical group (*T*-scores 60 to 64; see Tables 8 and 9). Four of these datasets were created. Each of these was based on one of the CAARS-S:SV indices (Inattention, n = 15 [CAARS Inattention]; Hyperactivity-Impulsivity, n = 8 [CAARS Hyperactivity-

Impulsivity]; Total, n = 14 [CAARS Total]; ADHD Index, n = 10 [CAARS ADHD Index]).

Individuals in the clinical datasets reported having significantly more symptoms of ADHD than others in the ADHD group (p <.01). When compared with the total comparison group, clinical participants in the CAARS Total group demonstrated a significant group difference for accuracy for disgust faces (Wilks' λ = .87, F [7, 87] = 4.26; p < .05) and differences approaching significance for angry (Wilks' λ = .87, F [7, 87] = 3.79; p = .055) and sad faces (Wilks' λ = .87, F [7, 87] = 3.83; p = .053). Clinical participants in the ADHD Index group demonstrated a significant group difference for accuracy for pictures showing happy faces (Wilks' λ = .91, F [7, 83] = 4.00; p < .05). and a difference approaching significance for disgust faces (Wilks' λ = .91, F [7, 83] = 3.84; p = .053) Analyses performed with participants in the CAARS Inattention clinical group found no significant differences on the Affect Recognition Task, but a difference approaching significance for disgust faces (Wilks' λ = .95, F [7, 93] = 3.73, p = .056). Clinical participants in the CAARS Hyperactivity-Impulsivity group demonstrated no significant group differences for accuracy on the Affect Recognition Task, but a difference approaching significance for sad faces (Wilks' λ = .90, F [7, 81] = 3.07, p = .083).

Findings were similar when clinical participants were compared with the matched comparison group. When compared with the matched comparison group, clinical participants in the CAARS Total group demonstrated a significant group difference for accuracy for surprise faces (Wilks' λ = .85, F [7, 53] = 4.16; p < .05) and a group

difference approaching significance for disgust (Wilks' λ = .85, *F* [7, 53] = 3.47; *p* = .067). Participants in the CAARS ADHD Index group also demonstrated group differences approaching significance when compared with the matched comparison group (disgust faces (Wilks' λ = .90, *F* [7, 49] = 3.31; *p* = .074; happy faces (Wilks' λ = .90, *F* [7, 49] = 3.11; *p* = .083). Analyses performed with the CAARS Inattention dataset found no significant differences on the affect recognition measure, but a difference approaching significance for disgust faces (Wilks' λ = .94, *F* [7, 59] = 2.84, *p* = .097). No significant differences were found when participants in the CAARS Hyperactivity/Impulsivity dataset were compared to the comparison group (Wilks' λ = .84, *F* [7, 47] = 1.29, *p* = .27).

Table 8.
CAARS Total Clinical Group – CAARS-S:SV T-scores and Affect Recognition Task Accuracy

	Clinical Group (*n* = 14)		Comparison Group (*n* = 81)			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV						
Inattentive	70.14	7.79	47.30	6.40	117.9	.00
Hyper/Imp	66.00	6.68	44.00	6.72	115.9	.00
Total	71.71	5.80	45.55	7.13	157.1	.00
Index	61.57	10.28	45.55	6.13	52.7	.00
Affect Recognition Task Accuracy						
Angry	.51	.19	.61	.19	2.7	.11
Disgust	.71	.17	.61	.17	3.5	.07
Fear	.48	.18	.41	.23	.8	.39
Happy	.84	.16	.86	.13	.1	.79
Neutral	.86	.12	.89	.11	.8	.38
Sad	.40	.20	.48	.21	1.7	.19
Surprise	.65	.16	.73	.12	4.2	.05
Total	.64	.04	.66	.07	1.2	.28

CAARS-S:SV = Conners' Adult ADHD Rating Scale- Self –Report: Screening Version

Table 9.
CAARS ADHD Index Clinical Group – CAARS-S:SV T-scores and Affect Recognition Task Accuracy

	Clinical Group (n = 10)		Total Comparison Group (n = 81)			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV						
Inattentive	69.90	8.02	47.30	6.64	109.04	.00
Hyper/Imp	63.20	8.82	44.00	6.72	61.29	.00
Total	69.40	8.30	45.55	7.13	107.56	.00
Index	70.40	5.04	45.55	6.13	139.39	.00
Affect Recognition Task Accuracy						
Angry	.59	.23	.61	.19	.24	.63
Disgust	.72	.14	.61	.17	3.84	.05
Fear	.45	.22	.42	.23	.087	.78
Happy	.77	.18	.86	.13	4.00	.05
Neutral	.91	.08	.89	.11	.55	.46
Sad	.40	.15	.48	.21	2.77	.10
Surprise	.68	.23	.73	.12	.78	.38
Total	.68	.14	.66	.07	.78	.38

CAARS-S:SV = Conners' Adult ADHD Rating Scale- Self-Report: Screening Version

Next, all clinical participants were combined into a single file with duplicate entries deleted (n = 25) and compared with the total comparison group (n = 81) and the matched-pairs set (n = 47; see Table 10). Analyses performed with this dataset found no group differences on the Affect Recognition Task measures. This suggests that symptoms assessed by the CAARS-S:SV ADHD Index ("I'm always on the go," "I have a short fuse," "I still throw tantrums," etc.) are more strongly associated with affect recognition than symptoms of Inattention and Hyperactivity/Impulsivity. When participants in the clinical group were compared with the participants in the Subclinical ADHD group, ANOVAs demonstrated significant group differences when identifying disgust faces (Wilks' $\lambda = .82$, F [7, 40] = 4.68; $p < .05$) and happy faces (Wilks' $\lambda = .82$, F [7, 40] = 4.32; $p < .05$; see Table 11). Clinical participants performed better than those

in the Subclinical group on disgust faces, but worse on happy faces. When clinical participants were excluded to examine differences between the comparison group and those in the Subclinical ADHD group, no group differences on the affect recognition measure reached or approached significance (see Table 12). These findings suggest that within a college sample individuals with subclinical ADHD symptoms (i.e. CAARS-S:SV *T*-scores 60-64) do not differ from those in the comparison group in their ability to correctly identify facial expressions. However, individuals with clinically significant symptoms of ADHD (i.e., CAARS-S:SV *T*-scores 65 or greater) differ from individuals with subclinical symptoms in their ability to correctly identify disgust and happy and participants with CAARS-S:SV ADHD Index *T*-scores greater than 65 differ from those in the comparison group in their ability to correctly identify disgust and happy faces.

Table 10.
All Clinical versus Comparison Group – CAARS-S:SV T-scores and Affect Recognition Task Accuracy

	Clinical Group (n = 25)		Comparison Group (n = 81)			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV						
Inattentive	69.12	6.47	47.21	6.29	228.9	.00
Hyper/Imp	59.52	9.47	44.65	6.84	74.4	.00
Total	67.28	6.75	45.86	6.58	200.2	.00
Index	61.00	9.57	46.25	6.21	81.9	.00
Affect Recognition Task Accuracy						
Angry	.600	.19	.615	.18	0.1	.72
Disgust	.672	.17	.606	.18	2.7	.10
Fear	.436	.20	.430	.21	0.0	.90
Happy	.832	.14	.859	.13	0.8	.36
Neutral	.878	.11	.873	.16	0.0	.88
Sad	.486	.23	.507	.19	0.2	.66
Surprise	.688	.16	.718	.13	0.9	.35
Total	.656	.06	.660	.06	0.0	.83

CAARS-S:SV = Conners' Adult ADHD Rating Scale – Self-Report: Screening Version

Table 11.

Subclinical ADHD versus all Clinical – CAARS-S:SV T-scores and Affect Recognition Task Accuracy

	Clinical (n = 25)		Subclinical ADHD (n = 22)			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV						
Inattentive	69.12	6.47	60.39	4.38	29.4	.00
Hyper/Imp	59.52	9.47	53.57	6.45	6.4	.02
Total	67.28	6.75	58.87	3.17	29.7	.00
Index	61.00	9.57	55.13	6.32	6.2	.02
Affect Recognition Task Accuracy						
Angry	.600	.19	.598	.19	0.0	.97
Disgust	.672	.17	.565	.17	4.7	.04
Fear	.436	.20	.435	.16	0.0	.98
Happy	.832	.14	.911	.12	4.3	.04
Neutral	.878	.11	.891	.12	0.2	.68
Sad	.486	.23	.528	.21	0.4	.51
Surprise	.688	.16	.739	.12	1.5	.23
Total	.656	.06	.667	.05	0.4	.54

CAARS-S:SV = Conners' Adult ADHD Rating Scale – Self-Report: Screening Version

Table 12.

Subclinical ADHD versus Comparison Group – CAARS-S:SV T-scores and Affect Recognition Task Accuracy

	Subclinical ADHD Group (n = 22)		Comparison Group (n = 81)			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV						
Inattentive	60.39	4.38	47.21	6.29	88.6	.00
Hyper/Imp	53.57	6.45	44.65	6.84	31.1	.00
Total	58.87	3.17	45.86	6.58	84.0	.00
Index	55.13	6.32	46.25	6.21	36.4	.00
Affect Recognition Task Accuracy						
Angry	.60	.19	.61	.18	0.2	.69
Disgust	.57	.17	.61	.18	1.0	.33
Fear	.43	.16	.43	.21	0.0	.92
Happy	.91	.12	.86	.13	3.0	.09
Neutral	.89	.12	.87	.16	0.3	.60
Sad	.53	.21	.51	.19	0.2	.65
Surprise	.74	.12	.72	.13	0.5	.48
Total	.67	.05	.66	.06	0.2	.63

CAARS-S:SV = Conners' Adult ADHD Rating Scale – Self-Report: Screening Version

Hypothesis 1b- Affect Recognition Task Reaction Times

Total reaction time was positively correlated with relationship duration and with participant age (see Tables 13 and 14). Specifically, reaction times to faces displaying angry, happy, neutral, and sad faces were correlated with relationship duration and reaction times to angry, fear, happy, sad, and surprise faces were associated with participants' ages. Next, correlations were run to examine the relationship between reaction times for specific faces and the CAARS-S:SV indices (Bonferroni correction: p = .05 x ¼ = .0125), ESWLS subscales (Bonferroni correction: p = .05 x 1/6 = .008), BDI-II and BAI scores (Bonferroni correction: p = .05 x ½ = .025), ICC subscales (Bonferroni correction: p = .05 x 1/11 = .0045), and accuracy and reaction times for the control task (Bonferroni correction: p = .05 x ½ = .025; p = .01 x ½ = .005). Reaction time was not found to be correlated with the CAARS-S:SV indices, ESWLS scores, BDI-II, or BAI (see Table 15). Affect recognition reaction times for all facial expressions and the total score were significantly correlated the Age Labeling Task reaction time (p <.005) and with some of the ICC subscales. Reaction times for angry facial expressions were negatively correlated with ICC supportiveness (p < .025) and ICC immediacy (p < .005). No other facial expressions were correlated with ICC subscales.

Next, the researcher ran a MANOVA to examine group differences on reaction time for the Affect Recognition task. Inconsistent with the Rapport et al. (2002) study, affect recognition reaction time was not correlated with CAARS-S:SV scores and no group differences were found; therefore, the null hypothesis was supported (Wilks' λ =

.96, F [7, 120] = .72, p = .66; see Table 17). The researcher ran ANOVAs to examine data for group differences for total reaction time on the affect recognition measure and reaction times for specific facial expressions and none were found (see Table 17). However, a MANOVA indicated sex differences for some expressions (Wilks' λ = .95, F [7, 120] = .92, p = .49). ANOVAs found that female participants responded significantly faster for pictures portraying angry (F [1, 126] = 5.47, p <.05) and fearful faces (F [1, 126] = 4.86, p <.05) and there was a sex difference approaching significance on the task overall (F [1, 126] = 3.72, p = .056). These findings suggest that participants which take longer to decide which facial expression is being displayed have longer relationships. However, this finding was not supported by greater relationship satisfaction.

Table 13.
Pearson Correlations for Specific Emotions for the Affect Recognition Task Reaction Times (N = 128)

	1	2	3	4	5	6	7	8
Mean Reaction Time								
1. Angry	1	.71**	.66**	.61**	.58**	.57**	.67**	.86**
2. Disgust		1	.66**	.55**	.49**	.64**	.67**	.84**
3. Fear			1	.60**	.51**	.62**	.76**	.86**
4. Happy				1	.49**	.57**	.58**	.75**
5. Neutral					1	.45**	.52**	.69**
6. Sad						1	.58**	.79**
7. Surprise							1	.85**
8. Total								1

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

Table 14.
Pearson Correlation Matrix for Affect Recognition Task Reaction Times and Relationship Duration and Age (N = 128)

	Angry	Disgust	Fear	Happy	Neutral	Sad	Surprise	Total	Age
Age	.28**	.16	.31	.34**	.15	.30**	.21*	.30**	1
Relationship Duration	.18*	.09	.14	.28**	.18*	.18*	.12	.19*	.39**

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

Table 15.

Pearson Correlations for Affect Recognition Reaction Times, CAARS-S:SV, ESWLS, BDI-II, and BAI

	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise	Total
CAARS:S-SV Indices								
Inattention	-.05	-.05	.06	.02	-.01	-.06	.06	.00
Hyperactivity /Impulsivity	-.06	-.03	-.09	-.09	-.07	-.17	-.09	-.11
Total	-.06	-.04	.00	-.03	-.05	-.12	-.01	-.05
ADHD Index	-.13	-.10	-.13	-.11	-.03	-.06	-.04	-.11
ESWLS Subscales								
General	.00	.00	-.03	.02	.00	.04	-.05	.00
Social	-.08	-.02	-.12	-.10	-.05	-.02	-.10	-.08
Sex	-.07	-.03	-.04	.02	-.06	-.05	-.06	-.05
Relationship	.10	.00	-.04	.09	.07	-.03	-.07	.00
Self	-.06	.03	.02	.05	-.11	.05	.00	-.01
Total	.00	-.01	-.09	.04	-.02	-.01	-.09	-.04
BDI-II	-.07	-.13	-.05	-.11	-.10	-.05	-.06	-.09
BAI	-.02	-.02	-.06	-.06	-.03	-.07	-.06	-.05

Table 16.

Pearson Correlations for Affect Recognition Reaction Times, ICC, and FDT Age Labeling Task

	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise	Total
ICC Subscales								
Total	-.24	-.01	-.06	-.17	-.11	.03	-21*	-.13
Disclosure	-.16	-.01	-.09	-.10	-.07	-.03	-.11	-.10
Empathy	-.15	.02	.03	-.05	-.06	.03	-.05	-.04
Social Relaxation	-.21	-.08	-.07	-.13	-.03	-.04	-.17	-.14
Assertiveness	-.17	-.01	.02	-.09	-.08	.02	-.09	-.07
Altercentrism	-.01	.06	.10	.02	.05	.06	.00	.05
Interaction Management	.02	.11	.00	.05	-.02	.11	.00	.05
Expressiveness	-.18	-.05	-.06	-.16	-.03	.02	-.15	-.11
Supportiveness	-.26*	-.08	-.07	-.10	-.24	-.12	-.18	-.19
Immediacy	-.31**	-.12	-.11	-.15	-.22	-.09	-.25*	-.22
Environmental Control	-.17	-.07	.03	-.08	-.08	.04	-.12	-.08
FDT								
Accuracy	.13	.13	.12	-.04	.04	.11	.08	.12
Reaction Time	.58**	.53**	.54**	.43**	.57**	.44**	.56**	.65**

Table 17.
Mean Affect Recognition Task Reaction Times in Milliseconds by Group

	ADHD (n = 47)		Comparison Group (n = 81)		Total (N = 128)			
	Mean	*SD*	Mean	SD	Mean	SD	*F*	*p*
Reaction Time								
Angry	2623	750	2708	928	2677	864	0.3	.59
Disgust	2442	705	2508	680	2483	687	0.3	.60
Fear	2933	870	2792	867	2845	867	0.8	.38
Happy	1669	429	1684	533	1679	495	0.0	.87
Neutral	1947	653	1885	579	1908	606	0.3	.58
Sad	2815	768	2930	918	2887	864	0.5	.47
Surprise	2272	725	2237	731	2250	726	0.1	.80
Total	2384	562	2390	605	2388	587	0.0	.96

Hypothesis 2 -- Age Labeling (Control) Task

The Age Labeling Task was not significantly correlated with the BDI-II (Age Labeling Task RT, $p = .42$; FDT accuracy $p = .52$) or BAI (Age Labeling Task RT, $p = .70$; Age Labeling Task accuracy, $p = .43$). The Age Labeling Task accuracy score was significantly correlated with the Affect Recognition Task total accuracy score ($p < .01$), but not correlated to the score any of the individual emotions ($p > .05$). As this was a control task and both the Age Labeling Task and Affect Recognition Task are facial identification tasks, their relationship is not unexpected. The researcher performed ANOVAs to examine group differences for the Age Labeling Task accuracy and reaction time. These analyses found no significant group differences for accuracy (F [1, 126] = 1.49, $p > .05$) or reaction time (F [1, 126] = .08, $p > .05$) on the Age Labeling control task; therefore, the null hypothesis (H2) was supported. The control task accuracy and reaction time were not significantly correlated with any of the life satisfaction ($p = .13$ to .97) or interpersonal communication competence scales (Age Labeling Task RT, $p = .055$

to .991; Age Labeling Task accuracy, p =.09 to .94). The Age Labeling Task was also not significantly correlated with the CAARS-S:SV indices (Age Labeling Task RT, p = .43, .51, .86, and .34; Age Labeling Task accuracy, p = .50, .72, .81, and .79).

Hypothesis 3 – Emotion Specificity

In order to test the emotion specificity hypothesis, a MANOVA was computed comparing the ADHD and comparison groups' with their accuracy scores on the Facial Affect Task and the Age Labeling Task as the dependent variables. The results indicated that the effect was not significant when participants in the ADHD group were compared with the total comparison group (Wilks' λ = .99, F [2, 125] = .87, p = .42) or the matched pairs comparison group (Wilks' λ = .98, F [2, 91] = .75, p = .48). Therefore, there is an emotion specificity effect, as performance on the Age Labeling Task was not associated with performance on the Affect Recognition Task for either group.

Hypothesis 4 – ADHD Symptoms and Life Satisfaction

The null hypothesis that self-reported symptoms of ADHD as assessed by the CAARS-S:SV would not be correlated with life satisfaction (H4) was rejected. Correlations were computed between each of the ESWLS subscales and the four CAARS-S:SV indices (Bonferroni correction: p = 05 x ¼ = .0125; p = .01 x ¼ = .0025) and BDI-II and BAI (Bonferroni correction: : p = 05 x ½ = .025; p = .01 x ½ = .005). The CAARS-S:SV Inattention Index was negatively correlated with general life satisfaction (p < .0025), satisfaction with self (p < .0025), total life satisfaction (p < .0125) and positively correlated with depression (p < .005) and anxiety (p < .005) (see Tables 18-20). The CAARS-S:SV Hyperactivity-Impulsivity Index was also negatively

correlated with general life satisfaction (p <.0025) and positively correlated with depression and anxiety (p <.025). The CAARS-S:SV Total score was negatively correlated with general and satisfaction with self (p <.0025 and p <.0025) and positively correlated with depression (p < .025) and anxiety (p <.025). The relationship between the CAARS-S:SV Total score and total life satisfaction neared significance (p = .014). The CAARS-S:SV ADHD Index was negatively correlated with total, general, and satisfaction with self (p <.0125, <.0025 and <.0025, respectively) and positively correlated with depression and anxiety (p <.025). The researcher ran MANOVAs to examine group differences on the CAARS:S-SV indices. MANOVAs indicated significant group differences on the CAARS-S:SV for all four indices for both the total dataset (Wilks' λ = .34, F [4, 123] = 59.16, p < .05) and the matched-pairs dataset (Wilks' λ= .34, F [4, 89] = 43.34, p < .05; see Tables 18a – 18c). ANOVAs by sex indicated that females had higher mean CAARS-S:SV ADHD Index scores (Wilks' λ= .70, F [4, 123] = 13.19, p < .05; Group means = 51.7 versus 46.7).

Table 18a.
CAARS-S:SV T-Scores by Group, Total Dataset (N =128)

CAARS-S:SV Indices	ADHD (n = 47)		Comparison (n = 81)			
	Mean	SD	Mean	SD	*F*	*p*
Inattentive	64.91	7.13	47.21	6.29	213.6	.00
Hyperactivity/Impulsivity	56.83	8.64	44.65	6.84	77.4	.00
ADHD Index	58.26	8.69	46.25	6.21	82.3	.00
CAARS-S:SV Total	63.32	6.84	45.86	6.58	203.5	.00

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

Table 18b.

Pearson Correlation Matrix CAARS-S:SV Indices (N =128)

CAARS-S:SV Indices	Inattentive	Hyperactive/ Impulsive	Total	Index
Inattentive	1.00	.65**	.73**	.92**
Hyperactive/Impulsive		1.00	.63**	.89**
Total			1.00	.74**
Index				1.00

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

Table 18c.

CAARS-S:SV T-scores by Group, Matched-pairs Dataset (N = 94)

CAARS-S:SV Indices	ADHD (*n* = 47)		Matched (*n* = 47)			
	Mean	SD	Mean	SD	*F*	*p*
Inattentive	64.91	7.13	47.30	7.13	153.7	.00
Hyperactivity /Impulsivity	56.83	8.64	44..00	8.64	64.6	.00
ADHD Index	58.26	8.69	45.55	6.84	152.1	.00
Total	63.32	6.84	45.55	8.69	67.0	.00

Table 19.

Pearson Correlation Matrix CAARS-S:SV Indices and ESWLS (N =128)

		ESWLS					
		General	Social	Sex	Relation	Self	Total
CAARS-S:SV	Inattentive	-.26**	-.19	-.09	-.10	-.31**	-.25*
	Hyper/Imp	-.28**	-.01	-.07	-.02	-.19	-.13
	Total	-.29**	-.12	-.09	-.07	-.27**	-.21
	Index	-.37**	-.12	-.05	-.05	-.37**	-.22*
Life Satisfaction	General	1	.52**	.34**	.24**	.73**	.72**
	Social		1	.33**	.10	.48**	.61**
	Sex			1	.31**	.34**	.68**
	Relationship				1	.19*	.70**
	Self					1	.69**
	Total						1

*CAARS versus ESWLS *p < .0125, ** p < .0025; ESWLS * p<.05, ** p <.01*

Table 20a.

Pearson Correlation Matrix BDI-II, BAI and CAARS-S:SV (N = 128)

	CAARS-S:SV Indices			
	Inattention	Hyperactivity-Impulsivity	Total	ADHD Index
BDI-II	.55**	.48**	.56**	.67**
BAI	.35**	.36**	.39**	.45*

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

Table 20b.

Pearson Correlation Matrix BDI-II, BAI, and ESWLS (N = 128)

	ESWLS Scales					
	Total	General	Social	Sex	Relationship	Self
BDI-II	-.38**	-.51**	-.31**	-.11	-.08	-.56**
BAI	-.08	-.16	-.06	-.01	.02	-.17

* $p < .05$; ** $p < .01$

In addition to the correlations with CAARS-S:SV indices, the Extended Satisfaction with Life Scales were correlated with depression, ICC (Interpersonal Communication Competence Scale) indices, and other measures. The total life satisfaction score was negatively correlated with depression, and positively correlated with the ICC total score, and ICC scales assessing disclosure, empathy, social relaxation, interaction management, supportiveness, immediacy, and environmental control. The general life satisfaction score was negatively correlated with depression, and positively correlated with the ICC total score and ICC scales assessing disclosure, supportiveness, empathy, social relaxation, altercentrism, interaction management, and immediacy. The social life satisfaction score was positively correlated with the ICC total score and ICC scales assessing disclosure, social relaxation, assertiveness, interaction management, immediacy, environmental control, empathy, expressiveness, and supportiveness. The sexual life satisfaction score was positively correlated with the ICC total score and ICC

scales assessing interaction management, social relaxation, and supportiveness. Satisfaction with self as assessed by the ESWLS was negatively correlated with depression, and positively correlated with the ICC total score, and ICC scales assessing disclosure, social relaxation, assertiveness, interaction management, supportiveness, environmental control, and immediacy. Relationship life satisfaction as assessed by the ESWLS was positively correlated with relationship duration.

Next, the researcher ran ANOVAs and discovered significant group differences on the ESWLS. Participants in the ADHD group reported significantly lower total life satisfaction, general life satisfaction, and satisfaction with self (F [1, 126] = 8.06, $p < .01$; F [1, 126] = 9.30, $p < .01$, and F [1, 126] = 6.37, $p < .05$, respectively) and a difference approaching significance for social life satisfaction (F [1, 126] = 3.64, $p = .059$; see Table 21). But in support of the null hypothesis, ANOVAs found no group difference for relationship satisfaction; however, this may have been due to the small number of participants in relationships at the time of the study (fewer than half of each group) and the relatively brief nature of most participants' relationships. Females reported higher social life satisfaction (F [1, 126] = 4.56, $p < .05$). ANOVAs performed with the matched-pairs dataset produced similar results. When compared with the matched comparison group ($n = 47$), participants in the ADHD group ($n = 47$) reported significantly lower total life satisfaction (F [1, 92] = 8.06, $p < .01$), general life satisfaction F [1, 92] = 9.30, $p < .01$), and satisfaction with self (F [1, 92] = 6.37, $p < .05$). The group difference for social life satisfaction approached significance F [1, 92] = 3.64, $p = .059$).

When clinical datasets were used, ANOVAs demonstrated significant group differences between the clinical sets and the comparison group on the ESWLS. Participants in the CAARS Inattention dataset significantly lower total life satisfaction, general life satisfaction, and satisfaction with self (F [1, 13] = 8.07, $p < .01$; F [1, 13] = 11.52, $p < .01$); and F [1, 13] = 9.79; $p < .01$, respectively). Participants in the CAARS-Hyperactivity-Impulsivity group also reported significantly lower total life satisfaction, general life satisfaction, and satisfaction with self (F [1,6] = 4.51; $p < .05$; F [1,6] = 7.34, $p < .01$; and F [1,6] = 4.86; $p < .05$, respectively). Participants in the CAARS Total group reported significantly lower total life satisfaction, general life satisfaction, and satisfaction with self (F [1,12] = 11.13; $p = .< .01$; F [1, 12] = 11.50, $p < .01$; and F [1, 12] = 14.03; $p < .01$, respectively). The group difference on the ESWLS for relationship satisfaction approached significance (F [1, 12] = 3.21, $p = .079$). Finally, participants in the CAARS ADHD Index group reported significantly lower total life satisfaction, general life satisfaction and satisfaction with self (F [1, 5] = 5.21; $p < .05$; F [1, 5] = 25.36, $p < .01$; and F [1, 5] = 16.50; $p < .01$, respectively). When all of the participants with clinically significant CAARS-S:SV scores were compared with the comparison group they reported lower general life satisfaction (F [1, 23] =10.72, $p < .01$), satisfaction with self (F [1, 23] = 1.93, $p < .01$), total life satisfaction (F [1, 23] = 11.14, $p < .01$), and social life satisfaction (F [1, 23] = 16.76, $p < .05$). The responses of the participants in the Subclinical ADHD group (i.e. CAARS-S:SV T-scores 60-64) responses on the ESWLS did not differ significant from the comparison group for any scale, but reported significantly greater general life satisfaction than participants in the Clinical group.

Table 21.
ESWLS Scores by Group

Life Satisfaction Scales	ADHD (n = 47)		Comparison (n = 81)		F	p
	Mean	SD	Mean	SD		
General	21.96	6.42	25.26	5.59	9.3	.00
Social	21.53	6.13	23.91	7.17	3.6	.06
Sex	20.89	7.11	23.42	8.87	2.8	.10
Relationship	12.81	12.91	16.16	14.30	1.8	.19
Self	22.70	7.17	25.52	5.37	6.4	.01
Total	99.89	29.57	1114.20	26.21	8.1	.01

Hypothesis 5 – ADHD Symptoms and Interpersonal Communication Competence

Correlations were run to examine the relationship between the ICC subscales and the ESWLS subscales (Bonferroni correction: $p = .05 \times 1/11 = .0045$; $p = .01 \times 1/11 = .0009$) and the BDI-II and BAI (Bonferroni correction: $p = .05 \times ½ = .025$). The ICC scales tended to be positively correlated with the ESWLS (see Tables 22 and 23), and negatively correlated with BDI-II, and BAI. It was not found to be correlated with scores on the Affect Recognition Task (see Table 6). The ICC total score was positively correlated with total life satisfaction ($p < .0009$) and social life satisfaction ($p < .0009$) and satisfaction with self ($p < .0009$). It was negatively correlated with depression ($p < .025$). The ICC disclosure score was positively correlated with social life satisfaction ($p < .0045$). The correlation between ICC disclosure and satisfaction with self neared significance ($p = .005$). The ICC empathy score was not significantly correlated with the ESWLS. ICC social relaxation was positively correlated with social life satisfaction ($p < .0045$), satisfaction with self ($p < .00$), and total life satisfaction ($p < .0009$). The ICC assertiveness score was positively correlated with social life satisfaction ($p < .0009$) and

the negative correlation with anxiety neared significance ($p = .025$). The ICC interaction management score was positively correlated with social life satisfaction ($p < .0045$) and the total ESWLS score ($p < .0009$). The correlation between the ICC interaction management and satisfaction with self neared significance ($p = .005$). The ICC supportiveness score was positively correlated with general ($p < .0045$), satisfaction with self ($p < .0009$), and the total ESWLS score ($p < .0009$). It was negatively correlated with depression ($p < .0045$). The correlation between ICC supportiveness and social life satisfaction neared significance ($p = .005$). The ICC immediacy score was positively correlated with social life satisfaction ($p < .0045$). The ICC environmental control score was positively correlated with total life satisfaction ($p < .0045$), social life satisfaction ($p < .0009$), and satisfaction with self ($p < .0009$). It was negatively correlated with depression ($p < .025$). The ICC altercentrism and expressiveness scores were not correlated with the ESWLS, BDI-II or BAI.

ANOVAs were run to examine differences between the ADHD and comparison groups. Results suggested that participants in the ADHD group reported less empathy; however, this difference did not reach significance (F [1, 126] = 2.94, $p = .089$). When clinical participants (CAARS-S:SV T score >64, $n = 25$) were compared with the comparison ($n = 81$), they reported significantly lower ICC expressiveness (F [1, 126] = 21.14, $p < .05$), altercentrism (F [1, 126] = 4.38, $p < .05$), and supportiveness (F [1, 126] = 20.04, $p < .05$). Group differences for disclosure and immediacy neared significance ($p = .074$ and .058, respectively). When compared with the matched-pairs dataset ($n = 47$),

group differences for expressiveness and altercentrism remained significant (expressiveness F [1, 92] = 30.15, $p < .01$; altercentrism F [1, 126] = 10.12, $p < .05$).

Participants in the Subclinical ADHD group (CAARS:S-SV T scores 60-64) reported significantly lower ICC empathy than those in the comparison group (F [1, 20] = 5.14, $p < .05$). When compared with clinical participants (n = 25), individuals in the Subclinical ADHD group reported significantly greater immediacy (F [1, 20] = 4.41, $p < .05$). The group difference in supportiveness neared significance (p = .071). Clinical participants reported more empathy and altercentrism that those in the Subclinical ADHD group; however, these differences did not reach significance (p = .07 and .06, respectively). Analyses by sex demonstrated that females reported higher ICC altercentrism (F [1, 126] = 11.23, $p < .01$) and more ICC empathy (F [1, 126] = 4.0, $p < .05$). In summary, individuals with symptoms of ADHD report significant deficits in interpersonal communication. Specifically, they report deficits in empathy, expressiveness, supportiveness, and trends toward significance for self-disclosure and immediacy. These deficits are consistent with the relationship problems found among individuals with ADHD in previous research.

Table 22.
Pearson Correlations between ICC and ESWLS Scales (N =128)

	ESWLS					
ICC	General	Social	Sex	Relationship	Self	Total
Self-disclosure	.23	.30*	.12	.04	.25	.23
Empathy	.21	.20	.15	.10	.14	.22
Social Relaxation	.19	.30*	.18	.15	.31**	.31**
Assertiveness	.10	.28*	.07	.00	.24	.17
Interaction Management	.22	.28*	.24	.16	.24	.32**
Altercentrism	.17	.15	.07	.07	.10	.15
Expressiveness	.11	.20	.12	.05	.15	.17
Supportiveness	.25*	.23	.18	.06	.33**	.26*
Immediacy	.20	.26*	.13	.00	.22	.19
Environmental Control	.17	.38**	.10	.11	.36**	.29*
Total	.24	.36**	.23	.14	.33**	.35**

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

Table 23.
Pearson Correlations for ICC, BDI-II, and BAI (N = 128)

	ICC Subscales					
	Total	Disclosure	Empathy	Social Relaxation	Assertiveness	Altercentrism
BDI-II	-.23*	-.14	-.13	-.15	-.16	.11
BAI	-.10	-.08	.001	-.11	-.21	.13

	ICC Subscales (continued)				
	Interaction Management	Expressiveness	Supportiveness	Immediacy	Environmental Control
BDI-II	-.05	-.18	-.20*	-.13	-.23*
BAI	.009	-.09	-.08	-.08	-.17

Additional Analyses – Anxiety and Depression

Correlations were run to examine the relationships between anxiety and depression and the CAARS-S:SV Indices (Bonferroni correction: $p = .05 \times ¼ = .0125$), ESWLS subscales (Bonferroni correction: $p = .05 \times 1/6 = .008$, $p = .01 \times 1/6 = .001$), and the ICC subscales Bonferroni correction: $p = .05 \times 1/11 = .0045$). Anxiety and

depression were positively correlated with all four indices of the CAARS-S:SV ($p <$ .0125). Anxiety was not correlated with any of the ICC subscales or the ESWLS. Depression was negatively correlated with the ICC total score ($p < .025$) and total, general, social life satisfaction, and satisfaction with self ($p <.001$). ANOVAs indicated that participants in the ADHD group reported significantly more symptoms of depression (F [1, 126] = 43.22; $p< .01$) and anxiety (F [1, 126] = 15.68; $p < .01$; see Table 24). Subsequent ANOVAs also demonstrated gender differences approaching significance on the BDI-II (F [1, 126] = 3.66; $p = .058$).

Table 24.
BDI-II and BAI Scores by Group, Total Dataset

		Attention Problems ($n = 47$)	Total Comparison ($n = 81$)	Total ($N = 128$)	F	p
BDI-II	Mean	13.91	7.20	9.78	43.2	.00
	SD	6.25	5.14	6.55		
	Min	2	0	0		
	Max	25	21	25		
BAI	Mean	11.06	7.19	8.66	15.7	.00
	SD	6.20	4.78	5.65		
	Min	1	0	0		
	Max	25	21	25		

Next, analyses were performed using the matched-pairs comparison group and the clinical datasets. Analyses using the matched-pairs set were similar to those using the total comparison group and significant group differences were found for depression (F [1, 92] = 36.14; $p < .01$) and anxiety (F [1, 92] = 13.79; $p < .01$, see Table 25). Significant group differences in depression and anxiety were found for all four CAARS-S:SV indices

$p < .01$) and when those in the comparison group were compared with participants in the Clinical group ($p < .01$; see Table 26). In addition to differing from the comparison group, participants in the Clinical group reported more symptoms of depression than those in the Subclinical ADHD group (F [1,20] = 6.85; $p < .05$; see Table 27). Also the Subclinical ADHD group reported significantly more symptoms of depression (F [1, 20] = 28.96; $p < .01$) and anxiety (F [1, 20]= 11.49; $p < .01$, see Table 28) than those in the comparison group. In summary, the symptoms of ADHD as assessed by the CAARS-S:SV indices were significantly correlated with reports of depression and anxiety. In addition, depression and anxiety are strongly related with self-reported life satisfaction and communication competence.

Table 25.
BDI-II and BAI Scores by Group, Matched-pairs Dataset

		ADHD Group (n = 47)	Comparison Group (n = 47)	Total (n = 94)	F	p
BDI-II	Mean	13.91	7.02	10.47	36.1	.00
	SD	6.25	4.77	6.52		
	Min	2	0			
	Max	25	21			
BAI	Mean	11.06	6.79	8.93	13.8	.00
	SD	6.20	4.89	5.95		
	Min	1	0			
	Max	25	21			

Table 26.
Depression and Anxiety Group Differences by Dataset

	Clinical		Comparison			
	Mean	SD	Mean	SD	*F*	*p*
CAARS-S:SV Inattention						
BDI-II	17.06	1.35	7.20	.60	44.73	.00
BAI	11.56	1.26	7.19	.56	10.06	.00
CAARS-S:SV Hyperactivity/Impulsivity						
BDI-II	7.19	.53	7.20	.58	26.91	.00
BAI	13.25	1.68	16.38	1.83	11.91	.00
CAARS-S:SV Total						
BDI-II	16.86	6.38	7.02	4.77	39.1	.00
BAI	12.00	4.66	6.79	4.89	12.5	.00
CAARS-S:SV Index						
BDI-II	19.29	7.72	7.02	4.77	33.9	.00
BAI	12.00	5.10	6.79	4.89	6.9	.01
All Clinical						
BDI-II	16.32	6.80	7.20	5.14	51.2	.00
BAI	11.44	5.94	7.19	4.78	13.5	.00

Table 27
Subclinical ADHD versus all Clinical

	Clinical (n = 25)		Subclinical ADHD (n = 22)			
	Mean	SD	Mean	SD	*F*	*p*
BDI-II	16.32	6.80	11.78	5.04	6.796	.01
BAI	11.44	5.94	10.83	6.51	.117	.73

Table 28.
Subclinical ADHD versus Comparison Group

	Subclinical ADHD (n = 22)		Comparison (n = 81)			
	Mean	SD	Mean	SD	*F*	*p*
BDI-II	12.98	.81	7.02	.75	28.96	.00
BAI	10.90	.89	6.79	.82	11.49	.00

Discussion

Although typically associated with childhood, attentional difficulties often persist into adolescence and adulthood. Even individuals who exhibit symptoms of ADHD, but do not meet diagnostic criteria for the disorder, often continue to have a variety of difficulties (Campbell, 2000; Goldstein, 1997; Murphy & Barkley, 1996; Barkley, 1998; et al.). Social deficits and interpersonal difficulties tend to have the most enduring impact (Shaw-Zirt, Popali-Lehane, Chaplin, & Bergman, 2005; Campbell, 2000; et al.). While researchers have discovered that adults with the full manifestation of the clinical condition of ADHD and those who have subclinical signs of the disorder have deficits in executive functioning, lower GAF (Global Assessment of Functioning) scores, deficits in attention, and more interpersonal problems such as marital difficulties and school and work performance problems, we know little about the causes of these deficits.

This study focused on a potential cause of problems in interpersonal relationships experienced by persons with ADHD. Some researchers have found that individuals with ADHD show deficits on affect recognition tasks which may be one of the reasons for their poor social relationships (i.e. Rapport et al., 2002; Shapiro, Hughes, August, & Bloomquist, 1993). The present study sought to replicate the findings of the Rapport study (2002) and to expand on their findings by examining affect recognition in a subclinical ADHD population (i.e. – in individuals with attention problems which do not

meet diagnostic criteria for ADHD), examining the relationship between affect recognition and life satisfaction, relationship satisfaction, interpersonal communication competence (ICC), and relationship status and duration. In addition, the researcher examined the relationship between symptoms of ADHD and other indices of life satisfaction and attempted to replicate the findings of previous researchers which have found increased anxiety and depression (Biederman et al., 1993; Jensen, Shervette, Xenakis, & Richters, 1993; Campbell, 2000; Treuting & Hinshaw, 2001) among individuals with attentional deficits.

The present study included a multiethnic sample of undergraduate students at George Mason University who were enrolled in introductory psychology courses and part of the university's research participant pool ($N = 128$). Forty-seven participants were placed in the ADHD group and compared with the total comparison group. The majority of participants in the ADHD group reported having subclinical symptoms of ADHD. Although most participants in the ADHD group did not report having symptoms severe enough to warrant a diagnosis of ADHD, they reported having significantly more symptoms of ADHD than those in the comparison group.

Hypothesis 1 – ADHD Symptoms and Affect Recognition. Participants in the ADHD group did not differ from those in the comparison group in their ability to correctly label facial emotion expressions; therefore, the null hypothesis was supported. However, additional analyses with clinical subsets of participants demonstrated differences for some emotions. Participants in the CAARS Total group performed significantly better than those in the comparison group on disgust faces and demonstrated

a difference suggesting significance for angry faces. Participants in the CAARS ADHD Index group made significantly more errors when labeling happy faces and performed better than participants in the comparison group on disgust faces. When all participants with CAARS-S:SV *T*-scores 65 or greater were compared with the Subclinical ADHD group, ANOVAs found that they had more difficulty identifying happy faces, but performed better than participants in the Subclinical ADHD group when identifying disgust faces. In the Rapport et al. (2002) study, participants with ADHD were significantly less accurate in identifying happy, angry, and fearful faces. Thus, the present study did not replicate the Rapport et al. (2002) finding that individuals with elevated symptoms of ADHD demonstrate an overall deficit on the affect recognition measure; however, the finding that individuals with attention problems differed from the comparison group on some emotions and not others, was consistent with Rapport et al. (2002). This suggests that while individuals with subclinical ADHD symptoms do not tend to differ from peers on an affect recognition task, adults with clinically significant ADHD symptoms, as assessed by the CAARS-S:SV in the present study, do demonstrate deficits for some facial expressions.

The present study differed from the Rapport et al. (2002) study in several important ways. First, this study utilized the NimStim picture set instead of the Diagnostic Assessment of Nonverbal Accuracy (DANVA) and the Ekman Faces task. Although both the DANVA and NimStim stimulus sets include color photographs (the Ekman Faces task includes black and white photographs), the DANVA includes only 24 photographs (versus 120) picturing only happy, sad, angry, and fearful faces, while the

NimStim also includes disgust, neutral, and surprise faces. In addition, the NimStim is composed of newer, higher resolution photographs and has a more ethnically diverse collection. Also, as the researcher selected photographs from the NimStim stimulus set using a strategy to minimize ceiling and floor effects, the selection of moderately difficult pictures for all 7 emotions may have produced some error into the stimulus set as emotions naturally vary in their degree of difficulty.

Previous affect recognition research with a variety of populations has found that some emotion categories are more difficult than others to interpret. In a study of facial affect perception among alcoholics, Frigerio, Burt, Montagne, Murray, and Perrett (2002) found that, overall, alcoholics made more errors than controls and, specifically, they tended to mislabel sad faces as angry or disgusted. Similarly, Lembke and Ketter (2002) found that when compared to healthy comparisons, euthymic bipolar I participants, and bipolar II participants, manic participants with bipolar I disorder showed poorer overall recognition of facial affect. Specifically, they had more difficulty with expressions of fear and disgust than healthy subjects. A review article by Kohler, Turner, Gur, and Gur (2004) concluded that individuals with schizophrenia, bipolar disorder, acute depression, developmental disabilities, and individuals with right hemispheric brain damage often had affect recognition deficits with expressions of fear, sad, and disgust faces. Also, among healthy participants happy faces tend to be the easiest to identify, followed by neutral, fear, sadness, anger, and disgust faces which are the most difficult. Given this finding, it is not surprising that disgust, anger, and fear were the emotions that

distinguished participants from the comparison group from individuals with significant symptoms of ADHD.

There are several possible explanations for why this study's findings differ from those of the Rapport et al. (2002). First, the use of a college sample restricted the range of ADHD symptoms may have obscured any group differences. Second, the college sample may have differed from the community sample used by Rapport et al (2002) in education, age, or in other ways that may have impacted their performance on the affect recognition task. Also, the present study included participants with primarily inattentive symptoms, primarily hyperactive symptoms, or a combination, while participants with primarily inattentive symptoms were excluded in the Rapport et al. (2002) study.

Reaction Time. Reaction time correlated positively with age and relationship duration; however, this study did not replicate the previous study's finding that participants with attention problems take longer to select the emotion displayed on an affect recognition task. In the present study, individuals in the ADHD group did not differ significantly from those in the comparison group in the amount of time they required to label emotions. First, as was noted above, one possible reason for this study's findings, which differ from those in the Rapport et al. (2002) study, were the differences in the affect recognition measure utilized. Second, because the present study used more photographs to assess affect recognition, as participants became more familiar with the task, they may have increased their response time. Third, differences in reaction time may only be present when comparison group participants were compared with individuals with greater ADHD symptomatology. As most participants of the present

study had subthreshold ADHD symptoms and were currently enrolled in college, their deficits may have been less prominent. Fourth, the present study's participants differed from the Rapport et al. (2002) sample in age. The previous study's participants ranged from 18 to 64 years (ADHD group M = 36.3 years; comparison group M = 33.4 years). As age was significantly correlated with reaction time for the total NimStim accuracy score (r = .30, $p < .01$) and for several specific emotions (angry r = .28, $p < .01$; happy r = .34, $p < .01$; sad r = .30, $p < .01$, and surprise r = .21, $p < .015$) this may explain some of the different findings. As noted previously, the present study included participants with primarily inattentive symptoms while participants such as these were excluded in the Rapport et al. (2002) study.

Hypothesis 2 – Age Labeling Control Task. ANOVAs found no significant group differences for accuracy or reaction times for the Age Labeling Control Task; therefore, the null hypothesis (H2) was accepted. Neither the control task accuracy nor reaction time were significantly correlated with any of the ESWLS indices or ICC scales. In addition, the Age Labeling Task was not significantly correlated with attention problems or self-reported symptoms of depression or anxiety. However, the Age Labeling Task was significantly correlated with the Affect Recognition Task total accuracy.

Hypothesis 3 – Emotion Specificity Hypothesis. A MANOVA with accuracy on the two facial tasks (Facial Affect Recognition and Age Labeling) found that the model was not significant. Therefore, the findings of this study did not support an emotion specific face processing deficit in individuals with high ADHD scores. Performance on a

Facial Affect Recognition Task was not related to participants' accuracy on an Age Labeling Task.

Hypothesis 4 – ADHD Symptoms and Life Satisfaction. The present study found that the participants in the ADHD group reported significantly less total life satisfaction, general life satisfaction, and satisfaction with self. They also reported less social life satisfaction; however, this difference did not reach significance. These findings remained significant and were even more pronounced when clinical participants were compared with participants in the comparison group. While the participants in the Subclinical ADHD group did not differ significantly from participants in the comparison group, they did report significantly more general life satisfaction than clinical participants. While the present study's hypothesis that participants in the ADHD group would report less relationship satisfaction was rejected, findings suggest that individuals with symptoms of ADHD are less satisfied with their lives in general and with themselves. These differences were especially pronounced among those with clinically significant symptoms of ADHD.

Hypothesis 5 – ADHD Symptoms and Interpersonal Communication Competence. The ICC scales tended to be positively correlated with the ESWLS, and negatively correlated with BDI-II, and BAI. Most ICC scales were correlated with total life satisfaction, general life satisfaction, social life satisfaction, and negatively correlated with depression. Analyses of group differences suggested that participants in the ADHD group reported less empathy; however this difference did not reach significance. Clinical participants (CAARS-S:SV *T*-score >64) reported significantly lower ICC

expressiveness, altercentrism, and supportiveness than participants in the comparison group. Group differences for disclosure and immediacy neared significance. These findings are consistent with those of Shaw-Zirt, Popali-Lehane, Chaplin, and Bergman (2005) who found deficits in self-esteem and social skills among individuals with ADHD in a college sample. Participants in the Subclinical ADHD group (*T*-scores 60-64) reported significantly lower ICC empathy than participants in the comparison group and significantly greater immediacy than those in the clinical group. The group difference in supportiveness neared significance. Clinical participants reported more empathy and altercentrism that those in the Subclinical ADHD group; however, these differences did not reach significance. Analyses by sex demonstrated that females reported higher ICC altercentrism and more ICC empathy. In summary, individuals with symptoms of ADHD feel that they are less able to feel what others are feeling, communicate their own feelings through nonverbal behaviors, and demonstrate supportive behaviors in communication. They also describe themselves as less interested in others and their point of view and less able to adjust to the needs of others. Their reported deficits in self-disclosure (the ability to open up to others) and immediacy (openness and approachability) also neared significance. So, although there was not a significant difference between participants in the ADHD group and participants in the comparison group for relationship satisfaction, they do report significant differences in their communication skills. This finding is consistent with the Eakin, Hechtman, Ochs, Krane, Bouffard, Greenfield et al. (2004) study which found that spouses of ADHD reported less perceived marital satisfaction and the Canu and Carlson (2003) study which found significant differences among college

students with ADHD – Inattentive type, ADHD – Combined type, and normal controls in assessments of interpersonal skills including comfort and the ability to handle social situations.

Additional Analyses – Depression and Anxiety. Consistent with the findings of previous studies in which researchers examined symptoms of depression and anxiety in individuals with ADHD (e.g. Nigg et al., 2005), in the present study, individuals in the ADHD group reported having greater symptoms of depression and anxiety. The mean BDI-II score for participants in the ADHD group was 13.91 compared with 7.20 among participants in the comparison group and the mean BAI score for the ADHD group was 11.06 versus 7.19 among participants in the comparison group. These group differences were even more evident when participants in the Clinical group were compared with comparison group participants (BDI-II Clinical Mean = 16.32, $F = 51.248$, $p < .01$; BAI Clinical Mean = 11.44, $F = 13.459$, $p < .01$). Even when participants in the Subclinical ADHD group (CAARS-S:SV *T*-scores 60-64) were compared with the comparison group these group differences remained significant.

These findings suggest that even if they are able to obtain admission to a university, individuals with subclinical or clinical symptoms of ADHD are more likely to experience symptoms of depression and anxiety than normal peers. Those with more severe symptoms of ADHD report even more symptoms of depression and anxiety than those with subclinical symptoms. The increased level of symptoms found in the present study's ADHD groups is consistent with the findings of other studies performed with children with ADHD (Treuting & Hinshaw, 2001; Jensen, Shervette, Xenakis, &

Richters, 1993; Scahill, Schwab-Stone, Merikangas, Leckman, Zhang, & Kasl, 1999) and adults with ADHD (Rapport et al., 2002; Murphy & Barkley, 1996; Fischer, Barkley, Smallish, & Fletcher, 2002). This suggests that even when symptoms are not sufficient to warrant a diagnosis, individuals with subclinical ADHD are more prone to symptoms of depression and anxiety. Despite the fact that many children with ADHD no longer have sufficient symptoms to retain the diagnosis in adulthood, this finding suggests that these individuals may still be at risk for depression and anxiety. Consequently, a goal for psychologists, parents, and other caregivers may be providing these children with coping skills to insulate them against symptoms of anxiety and depression.

Limitations and Future research. The present study had several important limitations. First, the use of a new affect recognition task prevented researchers from replicating the Rapport et al. (2002) study using the same measure. However, the NimStim stimulus set was selected because it utilizes more pictures, a more diverse collection of faces, and higher resolution images. Future research should make use of multiple affect recognition measures and assess additional nonverbal skills such as interpreting posture and voice characteristics such as tone, prosody, and volume. Second, while using a college sample was convenient, it limited the ages of participants and produced a sample that may have been less likely to be in romantic relationships and tended to be in brief relationships. As a result, the majority of participants had no romantic relationship for which to rate their satisfaction. Third, another difficulty with using a college sample is that adults with significant symptoms of ADHD are less likely to pursue post-secondary education (Mannuzza et al., 1991); therefore, the range of

ADHD symptoms in this study's sample was restricted. Individuals with the highest number of symptoms and most deficits would probably be more likely to demonstrate the facial affect recognition deficits that the present study hoped to observe. Future research should utilize a community sample to assess deficits in individuals with subthreshold and clinically significant ADHD. In addition, future research should obtain ratings of spouses and romantic partners to determine if participants' reported deficits in communication competence and satisfaction are observed by these informants. Given the deficits found among a college sample, an additional goal for future research would be a longitudinal study to examine these deficits over time or an experimental study to determine the impact of regular screening for anxiety and depression and to determine protective factors. As previous research has found differences in the overall brain volume and the size of some structures of individuals with ADHD, another area for research is to make use of fMRI techniques to examine differences in brain functioning while completing social perception or affect recognition tasks.

Conclusions. In summary, while participants with subthreshold ADHD did not differ significantly from the comparison group on an affect recognition task, participants with significant symptoms of ADHD did demonstrate deficits for some facial expressions. Also, the present study replicated previous findings that individuals with clinically significant symptoms of ADHD report more symptoms of depression and anxiety than peers and expanded on previous research by demonstrating that this difference remained significant even when a college sample with subthreshold symptoms of ADHD was compared with a comparison group. In addition, participants in the

ADHD group reported less total life satisfaction, general life satisfaction. Also, participants with clinically significant symptoms reported deficits in empathy, expressiveness, altercentrism, supportiveness and other communication competencies. Thus, although college students with subclinical symptoms of ADHD are similar to their peers on a variety of measures, they differ from their peers with regard to depression, anxiety, and life satisfaction. College students with significant symptoms of ADHD report even greater deficits including depression, anxiety, life satisfaction, communication competence, and affect recognition for some emotions. Consistent with previous research, symptoms of ADHD are found in adults and are significant enough to cause deficits.

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