ATTENTION-DEFICIT/HYPERACTIVITY DISORDER, STRESS, AND QUALITY OF LIFE IN ADULTHOOD

A Thesis
By
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FOREWORD

This thesis is written in accordance with the style of the *Publication Manual of the American Psychological Association (5th Edition)* as required by the Department of Psychology at Appalachian State University

The process of writing this thesis has been filled with ups and downs, but has also allowed me the opportunity to learn and grow in unexpected ways. For that, I would like to thank my thesis advisor, Will Canu, who stuck with me, despite my tendency to exaggerate the impact of minor set-backs. He provided advice and support that made this process manageable and enjoyable. Appreciation also goes out to my thesis committee, Josh Broman-Fulks and Courtney Rocheleau, who have each made important contributions to the development of this project. Making it to the end of this thesis process (or through graduate school) would not have been possible without my Clinical-Health cohort, all of whom provided much needed support and stress-relief. I would also like to thank Todd, for his patience in listening to me vent about thesis-related frustrations and offering encouragement that helped me stay motivated to the end. My sister, Lydia, also deserves my gratitude, as she constantly provided insights and advice that helped me to view difficulties from a different perspective, and ultimately made them easier to overcome. Finally, I wish to dedicate this thesis to my parents, Jim and Nancy Combs. Without their love, support, and constant encouragement, neither this thesis nor my graduate school experience would have been possible. There is no way to truly express to them how grateful I am for the life and love they have provided me.

Running head: ADHD, STRESS, AND QUALITY OF LIFE

Attention-Deficit/Hyperactivity Disorder, Stress, and Quality of Life in Adulthood

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Abstract

The symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) are linked to dysfunction in academic, occupational, interpersonal, and other domains for both children and adults (see review in Whalen, Jamner, Henker, Delfino, & Lozano, 2002). The current study examines the association between ADHD symptoms and quality of life (QOL) and perceived stress in a community sample of adults. Data were obtained largely through an internet survey conducted as part of a larger medical trial utilizing a representative community sample, and were analyzed through a series of hierarchical multiple regressions employing ADHD symptom clusters, demographic, and anxiety and depression scale variables as predictors. The hypotheses that ADHD symptoms positively predict perceived stress and negatively predict QOL were generally supported, with inattention and sluggish cognitive tempo serving as the strongest ADHD-related predictors for both QOL and perceived stress.

Attention-Deficit/Hyperactivity Disorder, Stress, and Quality of Life in Adulthood

In the past, it was commonly believed that Attention-Deficit/Hyperactivity Disorder (ADHD) affected only children and adolescents. Empirical research, however, has shown ADHD to be a life-long disorder, with ADHD traits continuing into adulthood in approximately 60% of diagnosed children and adolescents (Sobanski, Schredl, Kettler, & Alm, 2008). Some have even suggested that the prevalence rates of ADHD in childhood and adulthood are comparable, with 3-7% of children (American Psychiatric Association, APA, 2000) and 4.4% of adults (Kessler et al., 2006) demonstrating adequate symptoms to merit an ADHD diagnosis.

ADHD is primarily characterized by two symptom clusters, inattention (IA) and hyperactivity-impulsivity (HI), and is divided into types based on expressed symptoms in these clusters. The two most prevalent types are Primarily Inattentive (ADHD-IA) and Combined (i.e., prominent HI and IA symptoms), with the third subtype, Primarily Hyperactive (ADHD-HI), being much less prevalent and potentially developmentally limited to childhood (see below).

IA traits are characterized by a variety of behaviors, including difficulty concentrating, a tendency to daydream or become easily distracted, and lessened ability to organize and plan (Barkley, 2006). On the other hand, it has been suggested that the primary deficit of individuals with prominent HI symptoms is behavioral response inhibition (Barkley, 1997). Individuals with elevated HI tend to respond without waiting for directions to be completed or considering possible consequences (i.e., are more prone to engage in risky behaviors; Barkley, 2006). Other activities that require sharing, cooperation, and impulse control pose challenges for these individuals, as well (Barkley, 2006). Prevalence rates differ

between ADHD types. In the United States, the prevalence of ADHD-IA in children and adolescents has been estimated between 5.4 and 8.8% while approximately 2.6% display primarily hyperactive/impulsive traits. Individuals with symptoms of both inattention and hyperactivity/impulsivity make up the combined type (ADHD-C) of ADHD. The prevalence rate for ADHD-C in childhood is estimated at 4.7% (see review in Barkley, 2006).

Some research has shown that the diagnosis of a particular ADHD subtype tends to be associated with the age of the individual. One study by Nolan, Volpe, Gadow, and Sprafkin (1999) examined subtype prevalence in children and adolescents (ages 3 to 18) that had been referred to a child psychiatry outpatient clinic for ADHD symptoms. Sixty-three percent of the sample was diagnosed by a psychiatrist as meeting criteria for one of the ADHD types. The remaining 37% exhibited sub-clinical ADHD symptoms. Results from this study showed the mean age of individuals classified as ADHD-IA to be 11.98 (SD = 3.48), significantly higher than the mean age for the ADHD-HI group (M = 7.70, SD = 4.11) or the ADHD-C group (M = 8.63, SD = 4.35; Nolan et al., 1999). This would suggest HI to be more common in younger individuals, while inattention may be a more enduring symptom.

Research has traditionally indicated the prevalence of ADHD in males to be above that of females (see review in Barkley, 2006). Research by Nolan and colleagues (1999) found the ratio of ADHD in male children compared to female children to be similarly high across all three types (IA: 76% vs. 24%; HI: 81% vs. 19%; and C: 78% vs. 22%).

As evidence for the continuation of ADHD into adulthood accumulates, differences between the child and adult ADHD populations become clearer. Research has shown that, indeed, as children with ADHD-HI symptoms mature, these symptoms become less evident than they were in childhood (see review in Barkley, 2006). Although cognitive

manifestations of impulsivity (e.g., poor time management and a sense of restlessness) may still exist for the ADHD adult, the physical over-activity appears to be less evident (APA, 2000).

Due to the fact that ADHD manifests somewhat differently in adults than it does in children, for whom the DSM-IV-TR criteria were written, assessment of the disorder in older individuals poses certain challenges. For instance, inattention is a common, if sporadic, event for most adults; determination of what constitutes "abnormal" inattention can be subjective. Additionally, the diagnosis of ADHD in adults is dependent on self report of historical childhood symptoms, which invites risk of inaccuracy or incompleteness (Barkley, 2006).

For these reasons as well as others, attention has been paid to the development of diagnostic criteria appropriate for adults demonstrating ADHD symptoms (Barkley, 2006). In fact, Russell Barkley, a prominent ADHD researcher, has proposed new criteria for the diagnosis of ADHD in adults, taking into account the differences evident in adulthood (Barkley, Murphy, & Fischer, 2008). The trait of sluggish cognitive tempo (SCT), characterized by sluggishness, passivity, confusion, and hypoactivity has been linked to ADHD-IA in children (Barkley, 2006; Carlson & Mann, 2002). These symptoms appear to oppose those associated with ADHD-HI and, due partly to the fact that HI is not as prevalent in the adult population, SCT is now considered important to assess as a predictor of ADHD, and particularly the Inattentive type, in adults.

Symptoms associated with all three types of ADHD are generally associated with pervasive difficulties in academic, occupational, interpersonal, and emotional domains (Whalen, Jamner, Henker, Delfino, & Lozano, 2002). Long-term deficits in these areas seem very likely to affect a person's quality of life and overall level of perceived stress.

Academic Difficulties Associated with ADHD

Academic difficulty for those diagnosed with ADHD can begin at an early age, and is common. One study showed 68% of children in an ADHD group to have learning disabilities or academic problems, whereas only 21% of a non-diagnosed control group demonstrated such deficits (Loe et al., 2008). Further, while the intellectual ability of persons with ADHD has generally been shown to be comparable to those without the disorder (Barkley, 2006), a study by Loe and colleagues (2008) demonstrated that a sample of children with ADHD, who had also been referred for a developmental evaluation, performed poorly on the WISC-III (Weschler Intelligence Scale for Children), as compared to non-diagnosed peers (mean FSIQ 88.98 +/- 14.82, versus 101.58 +/- 14.01; Loe et al., 2008).

While the data are inconclusive regarding overall cognitive ability of typical students with ADHD, it is incontrovertible that many struggle academically (Barkley, 2006; DuPaul, 1991; McDonald-Richard, 1995; Reardon & Nagliery, 1992; Reaser, Prevatt, Petscher, & Proctor, 2007). In fact, Biederman and colleagues (1998) concluded that up to 84% of children with ADHD need academic assistance beyond the level of that given to non-diagnosed peers. Factors accounting for this population's academic difficulties are abundant, but inattention seems directly linked to the most common problems. These include attending to relevant classroom and academic information, executing necessary learning strategies such as planning and organizing (Reardon & Nagliery, 1992), implementing self-regulatory behaviors in academic settings, and persisting with tasks until completion (McDonald-Richard, 1995).

Gaub and Carlson (1997) explored behavioral, academic, and social differences among children with ADHD-IA, ADHD-HI, ADHD-C, and a non-diagnosed control group

(NC), based on teacher reports. While the ADHD-IA group garnered significantly higher appropriate behavior ratings than the other two diagnosed groups, it, along with the ADHD-C group, scored significantly lower than the ADHD-HI group on overall learning abilities. These results imply that learning difficulties and academic problems are less common in solely hyperactive-impulsive types, suggesting that, among the ADHD symptom clusters, inattention may be a more influential factor for learning difficulties.

While inattention may be primary in terms of effects on learning, hyperactivity and impulsivity (HI) have also been shown to have negative effects on academic performance. For those who are diagnosed with ADHD in the pre-school years, HI tends to be more present than inattention (Barkley, 2006), and the presence of HI at such an early stage generally predicts chronic behavior problems (Farrington, Loeber, & Van Kammen, 1990; Sonuga-Barke, Auerbach, Campbell, Daley, & Thompson, 2005), deficits in academic fluency (i.e., reading disorder) and, in some cases, intellectual impairment (DuPaul, McGoey, Eckert, & VanBrakle, 2001; McGee, Partridge, Williams, & Silva, 1991). Those with significant HI later demonstrate increased truancy, grade retention, and dropout (Barbaresi, Katusic, Colligan, Weaver, & Jacobsen, 2007) and other behavioral problems at school (Loe et al., 2008). In summary, inattention, hyperactivity, impulsivity, or a combination of these can negatively impact the general ability to perform the skills needed to succeed academically (Barkley, 2006).

Reaser and colleagues (2007) compared the learning strategies of college students with ADHD to peers with learning disabilities (LD) and another group without ADHD or LD, finding that the ADHD group demonstrated significantly lower achievement in the areas of main idea selection and test-taking strategies than either of the other two groups.

Additionally, the ADHD group performed lower than the non-diagnosed group in the areas of concentration (d = .40), motivation (d = 1.20), and information processing (d = .61; Reaser et al., 2007). These results reinforce the enduring negative impact that inattention, hyperactivity, and impulsivity can continue to have on academic functioning into adulthood.

Occupational Problems Associated with ADHD

Many of the deficits that affect those with ADHD academically, such as impaired attention, interpersonal skills, initiative, and task persistence, also hinder occupational functioning (Hill & Petty, 1995), which becomes increasingly evident as ADHD adolescents grow into adults and take on jobs requiring more skill and responsibility (Barkley, 2006). Not surprisingly, academic impairment has been demonstrated as a potential reason for later occupational dysfunction in those with ADHD. One study found that 32% of an ADHD sample had failed to complete high school, a finding that helps to explain a trend for ADHD adults to have both lower-status occupations (Weiss, Hechtman, Milroy, & Perlman, 1993) and lower general SES (Barkley, 2006) and supports the link between education level, occupational class, and income (Laaksonen, Rahkonen, Martikainen, & Lahelma, 2005). Evidence for occupational impairment in adults with a diagnosis of ADHD is varied and includes higher rates of being fired, laid off (Barkley, Fischer, Smallish, & Fletcher, 2006), and moving or changing jobs (Weiss et al., 1993), when compared to those without ADHD. Able, Johnston, Adler, and Swindle (2007) illustrate this trend, reporting adults with an ADHD diagnosis to have lower levels of full-time employment (70% vs. 88.6%) and higher frequency of unemployment (11% vs. 2.8%) than a group of non-symptomatic peers. Additional evidence for occupational impairment is found in long-term follow-up research by

Barkley and colleagues (2006) that reports significantly lower employer-rated job performance for adults with ADHD as compared to a non-diagnosed control group.

Interpersonal Difficulties Associated with ADHD

A large body of evidence suggests that ADHD children, regardless of type, experience more social difficulties than their non-diagnosed peers (e.g., Gaub & Carlson, 1997; see review in Canu & Carlson, 2004). Several researchers (e.g., Wheeler & Carlson, 1994; see review in Henker & Whalen, 1999) describe a tendency for children with the different ADHD types to display varying social dysfunctions; parents and teachers characterize ADHD-IA children as passive, shy, and socially withdrawn, whereas they describe ADHD-C children as inappropriately assertive, engaged to the point of intrusiveness, and emotionally labile (Maedgen & Carlson, 2000). When compared to their non-diagnosed peers, children with both types of ADHD experience increased levels of anxiety and depression associated with their social difficulties (Kellner, Houghton, & Douglas, 2003). Other research by Gaub and Carlson (1997) used teacher reports to assess the social functioning of children with all types of ADHD (-IA, -C, and -HI). Results showed all three groups as demonstrating significantly more social deficits than children without ADHD, with the ADHD-C group demonstrating the most. In addition, different levels of "peer dislike" were detected for each of the ADHD subgroups: fifty-nine percent of ADHD-IA and 53% and ADHD-HI group members were disliked by their peers, whereas the ADHD-C group had a higher rate of 82% (Gaub & Carlson, 1997), suggesting that when a significant number of both inattentive and hyperactivity-impulsive symptoms are present, social adjustment suffers more.

Empirical research has also suggested that children with ADHD have fewer friendships than children without the disorder (Erhardt & Hinshaw, 1994; Hoza et al., 2005; see review in Canu & Carlson, 2004). Male summer campers—regardless of ADHD status—tend to describe other male campers with ADHD as more negative and less positive than non-diagnosed peers after only three days of interaction, an effect that was replicated at the end of the five-week program (Erhardt & Hinshaw, 1994). Hoza and colleagues (2005) document 56% of ADHD children as having no dyadic friends, 33% with one dyadic friend, and 9% with two dyadic friends, as compared to 32%, 39%, and 22% in those categories for non-diagnosed children. Overall, in this study, ADHD children were described as more frequently rejected (52% vs. 14%) and less popular than other children (Hoza et al., 2005).

While ADHD-related social difficulties usually begin in childhood and have been found to continue into adolescence, it is becoming clear that affected adults also suffer relationally (Bagwell, Molina, Pelham, & Hoza, 2001; Barkley, 2006; Weiss & Murray, 2003). Research by Young and Gudjonsson (2006) compared a group of ADHD adults to sub-clinical ADHD and non-symptomatic groups using the Gough Socialization Scale (GSS), a measure of social adjustment difficulties, including struggles with forming and maintaining intimate relationships. Results showed the ADHD group to score similarly on the GSS to people meeting criteria for a personality disorder, equating to a substantially increased likelihood for social, relational, and adjustment problems.

It is possible that some social deficits experienced by those with ADHD may be the result of negative peer evaluation based on stigma toward ADHD as a mental disorder (Canu, Newman, Morrow, & Pope, 2008). Research has shown that college students desire less interaction with hypothetical peers with ADHD, across levels of personal intimacy, as

compared to peers with no differences besides lacking an ADHD diagnosis (Canu et al., 2008), which suggests that an adult ADHD label carries with it negative stigma. Adults with ADHD are also likely to struggle interpersonally as a result of their continued inattention, hyperactivity-impulsivity, or both (Robin & Payson, 2002).

In a study by Canu and Carlson (2003), interpersonal deficits were manifest in comparisons of male college students with ADHD-IA, ADHD-C, and no ADHD diagnosis. Those with ADHD-IA reported significantly lower levels of social comfort, assertiveness, and frequency of dating behaviors, as compared to the other two groups. Interestingly, in terms of heterosexual romantic outcomes, the ADHD-C group's adjustment seemed more or less indistinguishable from the control group. Emphasizing the social impairment of young men with ADHD-IA is the finding that, when blind to ADHD status, female confederates and observers reacted more negatively to males with ADHD-IA, across several measures, as compared to their reactions to those in the ADHD-C and control groups (Canu & Carlson, 2003). It has also been suggested that overactive perception of negative social evaluation combined with low social comfort (i.e., higher rejection sensitivity) may differentially and negatively affect individuals with ADHD-IA (versus those with ADHD-C), increasing the likelihood of their experiencing social difficulties and peer rejection (Canu & Carlson, 2007). Finally, elevated rates of relationship instability, spousal separation, and divorce have also been noted in the population of adults with ADHD (Barkley, 2006; Murphy & Barkley, 1996; Weiss & Murray, 2003).

Emotional Difficulties Associated with ADHD

Ample research has established that the problems associated with ADHD can lead to personal distress. In addition, those with ADHD also frequently meet criteria for a comorbid

Axis I disorder. The majority of research on ADHD comorbidity has focused on conduct disorder (CD), oppositional defiant disorder (ODD), and other childhood aggression. Far less attention has been paid to the mood and anxiety disorders (Jensen, Martin, & Cantwell, 1997), despite their high co-occurrence with ADHD.

Overall, anxiety disorders are present in up to 25% of children with ADHD, and clinical anxiety seems overrepresented in the adult ADHD population as well (Barkley, 2006). A study by Bohline (1985) found that teachers rated ADHD children as demonstrating more depressive features than non-diagnosed children, whereas research by Waring and Lapane (2008) found that when compared to their non-diagnosed peers, children with ADHD were approximately nine times as likely to experience significant depression, anxiety, or both. Research also suggests that the presence of CD and ODD with ADHD in childhood may serve as a predisposing factor for the development of anxiety and mood disorders later in life (Bagwell, Molina, Kashdan, Pelham, & Hoza, 2006; Barkley, 2006). Indeed, a study by Bagwell and colleagues (2001) comparing children with and without ADHD demonstrated that social anxiety disorder occurs in children who had been diagnosed with ADHD and comorbid CD or ODD at a rate of more than 2.5 times that of their non-diagnosed peers (Bagwell et al., 2001).

Regarding anxiety and depression comorbidity beyond adolescence, adults with ADHD, as compared to sub-clinical controls and non-symptomatic controls, report substantially more anxious and depressive experiences (Young & Gudjonsson, 2006). This trend is supported by Able and colleagues (2007), who examined a sample of adults without ADHD, with undiagnosed ADHD, and with a documented diagnosis of ADHD, and demonstrated that the undiagnosed ADHD group was more likely than non-diagnosed

controls to have experienced self-reported depression (31% vs. 12.9%), anxiety (19.8% vs. 7.3%), and bipolar disorder (5.9% vs. 0.9%). Additionally, the diagnosed ADHD group reported incrementally higher rates of these dysphoric moods as compared to their peers with undiagnosed ADHD (55.2% for depression, 30.1% for anxiety, and 10.3% for bipolar disorder). Considering many of the previously mentioned difficulties (e.g., academic, interpersonal difficulties) and their emotional toll (i.e., lower motivation, fewer friends), the adult with ADHD's heightened vulnerability for the development and maintenance of anxiety and other emotional problems becomes even clearer.

ADHD and Stress

Defining stress. Stress has typically been viewed as a negative emotional experience with the capacity to affect psychological and physical health (Taylor, 2006). When presented with a stressor, an individual experiences physiological, cognitive, and behavioral changes that facilitate coping and problem solving. However, the construct of stress is subjective, and is manifest differently in different people. Symptomatic responses to a potentially stressful stimulus differ among individuals, whose various appraisals of those symptoms as positive or negative contribute to the experience of stress (Taylor, 2006). The personal stress experience, therefore, can be physiological, emotional, or a combination of the two.

ADHD and stressor prevalence. Given information about the host of difficulties with which people with ADHD must deal (e.g., academic struggles, interpersonal rejection, comorbid mood or anxiety issues, as described above) it is logical to assume that the ADHD individual experiences increased levels of subjective, day-to-day stress. The impact of higher stress is likely not limited to the sufferer, but also probably affects family, friends, and one's personal environment, further supporting the assumption that ADHD individuals have a

higher number of stressors in their lives. ADHD exacts numerous costs (i.e., behavioral interventions, medication costs, time off from work; Riley, Lyman et al., 2006) upon families of diagnosed children and affected adults, alike, and the stress associated with such costs ultimately affects the environment (e.g., family living situation; Beitchman, Inglis, & Schachter, 1992; Lange et al., 2005). Research has shown that close to $3.7 billion was lost in 2000 in relation to ADHD, whether due to unemployment of family members who miss work due to problems associated with their children having ADHD or work loss among those with a diagnosis of ADHD (Birnbaum et al., 2005), illustrating the magnitude of economic stress incurred within a family. To the extent that the individual with ADHD realizes, or is made aware of, his or her contribution to family and general life stressors, personal subjective stress experience may also intensify.

Stress reactivity and ADHD. Direct research regarding the ADHD-personal stress association has focused mainly on physiological stress responses rather than on extent of subjective daily stressors. The physiological stress response and stress experience in adult ADHD patients has been examined by comparing the event-mediated arousal of adults with ADHD to that of non-diagnosed adults. In a study by Lackschewitz, Huther, and Kroner-Herwig (2008), the Trier Social Stress Tasks (comprised of a five minute simulated job interview and a five minute mental arithmetic task in front of a committee) were administered while heart rate and salivary cortisol levels were being measured. Following the task, the participants completed a questionnaire to explore the subjective stress experience. Results indicated elevated physiological stress responses and higher subjective stress among the ADHD adults when compared to the control group. Additional research supports this finding, suggesting dysregulation of the stress-mediating mechanisms (Randazzo, Dockray,

& Susman, 2008) is related to increased stress for those with pervasive ADHD symptoms (King, Barkley, & Barett, 1998). In fact, the levels of reported stress for those adults diagnosed with ADHD were elevated both in the presence of the stressor and in anticipation of it. Additionally, measures of heart rate and salivary cortisol demonstrated a greater difficulty in recovering from elevated stress levels in the ADHD group (Lackschewitz et al., 2008), indicating that persons with ADHD not only have a more severe physiological stress experience, but also face challenges in recovering from stress. These data provide evidence for the natural predisposition of an ADHD individual to higher stress reactivity.

Stress management skills and ADHD. Over a decade ago, inability to tolerate stress was proposed by Wender as an additional characteristic for the diagnosis of ADHD (Wender, 1995). Indeed, research has suggested that individuals with ADHD demonstrate lower coping skills in the face of stress (Riley, Spiel et al., 2006), a condition that could exacerbate the impact of stressors. Children with ADHD have been found to demonstrate lower self-esteem than non-diagnosed peers and, as a result, engage is less active approaches to solving interpersonal problems (Riley, Spiel et al., 2006). The symptoms of inattention, hyperactivity, and impulsivity are linked to lower levels of planning, organization, and self-control (Davis, Levitan, Smith, Tweed, & Curtis, 2006), which are critical to successful stress-management. Individuals with ADHD, especially those with primarily hyperactive or impulsive traits, tend to act immediately when presented with a complex stimulus rather than to engage in the often necessary problem-solving processes (Davis et al., 2006). If the stimulus is considered by the individual to be stressful, his or her impulsive response likely will not be well planned, and therefore is unlikely to actually alleviate stress.

ADHD and Quality of Life

The Centers for Disease Control and Prevention (CDC, 2009b) describes health-related quality of life (QOL) to be a personal perception of physical and mental health and well-being throughout the lifespan. Health-related quality of life has been incorporated into several areas of research, including as a measure of the effects of disorders. QOL has broadly been used to refer to many aspects of health and life satisfaction (CDC, 2009b).

While the literature in this area is not extensive, ADHD has been associated with various measures of impaired QOL (Riley, Spiel et al., 2006). Using parent reports, Riley, Spiel, and colleagues (2006) assessed the QOL of children in five domains: risk avoidance, achievement, satisfaction, resilience, and comfort. Children with ADHD reported low levels of well-being and self-worth (e.g., poor satisfaction), increased frequency of emotional and somatic complaints (e.g., low levels of comfort), decreased involvement in family and fewer coping skills (e.g., poor resilience), increased likelihood to engage in dangerous behaviors (e.g., poor risk avoidance), and poorer academic and social functioning (e.g., poor achievement), as compared to their non-diagnosed peers. All of these results are robust indices of lower QOL (Riley, Spiel et al., 2006).

Able and colleagues (2007) later examined the association of ADHD traits with adults' QOL. Using telephone surveys, the experimenters collected data on several aspects of QOL from adults diagnosed with ADHD, others reporting significant but undiagnosed ADHD symptoms, and peers without the disorder. Results showed that all adults with diagnosable levels of ADHD reported higher frequencies of past and present comorbid conditions, increased likelihood for family history of ADHD, lower levels of educational achievement, lower frequencies of full-time employment, lower socio-economic status, less

stability in interpersonal relationships, increased likelihood for depressive symptoms, and an increased risk for accidents and injuries (Able et al., 2007), which all speak to diminished QOL.

The extent of emotional QOL deficit experienced by adolescents with ADHD, who are already in a turbulent period of life, is illustrated by the research of Whalen and colleagues (2002). Self-reports from adolescents with moderate-to-high ADHD symptoms show increased frequency of anxiety, sadness, anger, and stress, as well as decreased happiness and positive well-being, when compared to other peers. Interestingly, despite previous evidence for social deficits, adolescents with high levels of ADHD also reported spending more time with peers and less time with family (Whalen et al., 2002), perhaps losing out on more intimate emotional support.

As noted previously, ADHD is a heterogeneous condition, sometimes presenting with comorbidities that may be more obvious or seem more urgent to medical or mental health professionals, and which may mask the underlying ADHD (Able et al., 2007). Anxiety, depression, conduct disorder, and learning disabilities are common comorbidities, as are other environmental stressors (e.g., disordered home or school environment; Able et al., 2007). Such comorbidities exacerbate the already turbulent daily social, emotional, and work experiences of those with ADHD, all of which are implicitly linked to subjective QOL.

ADHD has also been linked to problematic choices and behaviors that can have long-term effects on physical health, an additional aspect of QOL. Repeated evidence has been found linking ADHD symptoms to increased frequency of cigarette smoking (Lambert & Hartsough, 1998; Whalen et al., 2002; Whalen, Jamner, Henker, Gehricke, & King, 2003), and alcohol and drug abuse (Murphy & Barkley, 1996), as well as to less healthy diet choices

(Davis et al., 2006), and even obesity in adolescents (Cortese et al., 2007; Lam & Yang, 2007; Waring & Lapane, 2008) and adults (Altfas, 2002).

Summary and Rationale for the Current Study

A variety of life experiences in childhood and adulthood are negatively impacted by the presence of ADHD symptoms. Regardless of the fact that individuals with ADHD demonstrate comparable levels of intelligence to those without the disorder (Barkley, 2006), academic and occupational difficulty is common (Reaser et al., 2007; Barkley, 2006; Weiss et al., 1993). Cognitive abilities related to academic and occupational functioning, such as concentration, information processing, and motivation, are typically impaired in affected individuals (Reaser et al., 2007), as are interpersonal relationships in childhood (Erhardt & Hinshaw, 1994; Hoza et al., 2005; see review in Canu & Carlson, 2004) and adulthood (Barkley, 2006; Murphy & Barkley, 1996; Weiss & Murray, 2003).

Relatedly, individuals with ADHD have a higher prevalence of general emotional problems as well as meeting full criteria for mood disorders (Able et al., 2007; Young & Gudjonsson, 2006), as compared to non-diagnosed peers, and those with ADHD have been shown to be more physiologically reactive to stress (Lackschewitz et al., 2008). QOL of ADHD individuals is nearly certainly affected by dysfunction in all the aforementioned areas, but is also potentially impacted by their elevated likelihoods of smoking, drinking, unhealthy eating, and obesity (Davis et al., 2006; Lam & Yang, 2007; Murphy & Barkley, 1996; Whalen et al., 2002). In sum, the impact of ADHD is significant and plays a considerable role in the ADHD individual's experience of psychological and physiological well-being.

To date, however, research focusing on the health-and-happiness outcomes associated with ADHD has largely focused on children. With almost 1in 20 adults in the United States affected by ADHD (Kessler et al., 2006), it is clear that this older segment of the ADHD population warrants similar attention. Therefore, this study aimed to examine the impact that ADHD symptoms have on the psychological and physiological health of adults.

Specifically, QOL and perceived stress were assessed as dependent variables across an adult, community-recruited sample that is indexed by adult ADHD traits. Based on previous research, this project had clear hypotheses for ADHD's relation to the aforementioned outcomes in all age groups. A negative relationship was expected between the level of ADHD traits (i.e., IA, HI, Sluggish Cognitive Tempo, and newly proposed adult ADHD criteria) and every index of QOL (physical health, psychological QOL, social relationships, environmental QOL). The comparison of all ADHD traits to level of perceived stress was expected to yield a positive association.

Method

Participants

A sample of over 1,000 non-clinical, community participants from Watauga County in Western North Carolina was recruited via newspaper, radio, and online advertising to participate in a larger study examining the effects of an antioxidant trial on physical and psychological health. An incentive of $300 was offered for completion of the entire study, which involved a three month placebo or antioxidant regimen, baseline and post-trial physiological, cognitive, and online psychological assessments. The sample included males and females from the ages of 18 to 85, and was limited to participants who were non-institutionalized, not pregnant, and non-lactating. Participants were not excluded on the basis

of ethnicity, gender, or other physical or mental health status. The baseline survey included measures examined in the current study; nine-hundred-eighty-three participants (94.16% of original sample) completed ADHD measures and were included in this study. Sixty-one participants from the original sample were excluded from the current study due to incomplete data. The final study sample included 39.3% male and 60.7% female participants, 95.6% of whom were Caucasian. Age breakdown of the sample is as follows: 37.6% young adult (ages 18-40), 49.9% middle-aged (ages 41-65), and 12.4% at retirement age (ages 66-85). The majority of the sample was highly educated, with 81.6% having completed at least some college. An additional characteristic used to recruit the sample was Body Mass Index (BMI). In this sample, 46.6% of the sample were considered to have a normal BMI (18.5-24.9), 28.6% were overweight (25-29.9), and 24.8% were considered to be obese (30 or more). Additional details regarding the sample's composition are in Table 1.

Procedure

Data from the sample of 983 were collected in 2008, with 473 people participating in the spring (cohort one) and 510 people participating in the fall (cohort two). After giving written informed consent, participants completed baseline questionnaires and rating scales including an ADHD assessment scale based on *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV-TR*; APA, 2000) criteria and criteria recently proposed by Barkley and colleagues (2008) as relevant to adulthood, a QOL measure, and a perceived stress measure. While most of the questionnaires were administered online, spring participants were administered a paper-and-pencil version of the Perceived Stress Scale at the time of the baseline laboratory visit. In addition, a small proportion of all participants did not complete the online survey before presenting at baseline (due to limited internet access or other issues);

these individuals completed the survey in a computer laboratory during the course of their baseline visit. This study's procedures were reviewed and approved by the Institutional Review Board on May 1, 2009 (see Appendix A for IRB Approval Form and Appendix B for Consent Form for Human Subjects).

Measures

Current Symptom Scale (Barkley & Murphy, 2006). This self-report measure consists of 18 items tapping the inattentive and hyperactive-impulsive symptoms of ADHD as defined in the *DSM-IV-TR* (APA, 2000), and references behavior in the past six months. Example items include "Fidgeted with hands or feet or squirmed in seat" (hyperactivity-impulsivity) and "Didn't listen when spoken to directly" (inattention). Responses are made on a four-point Likert-type scale (0 = *never or rarely*; 3 = *very often*). A single item was added to assess overall impairment experienced by participants due to ADHD symptoms, using the same scale. In addition, three items tapping SCT, a cognitive style associated with the Inattentive Type of ADHD (see above for description; Carlson & Mann, 2002), were also added to each measure to examine the potential association of this distinct trait on health outcomes (see Appendix C for Current Symptom Scales). In the current sample, internal reliability for all scales was adequate, as assessed by Cronbach's alpha, $\alpha = .86$ (IA), .78 (HI), .73 (SCT).

Proposed Adult ADHD Criteria Scale (Barkley et al., 2008). This nine-item self-report measure has recently been shown in a large adult sample to more effectively distinguish ADHD from non-ADHD subgroups than the *DSM-IV-TR* ADHD criteria, which were developed using data derived from child and adolescent populations. Three items included in this symptom set are duplicates of *DSM-IV-TR* criteria; as these were assessed

using the Current Symptom Scale (see above) and included in the IA and HI scales, they were dropped for the purposes of independent analysis, creating a six-item form. Responses are given on a four-point scale similar to the Current and Childhood Symptom Scales (Barkley & Murphy, 2006) and reference the past six months; sample items include "Have difficulty stopping activities or behavior when I should do so" and "Have trouble doing things in the proper order or sequence" (see Appendix D for Proposed Adult ADHD Criteria). Internal consistency of the six- item Adult ADHD Criteria Scale used in this study was satisfactory, $\alpha = .70$.

World Health Organization Quality of Life Questionnaire, Brief Form (WHOQOL-BREF; Bonomi, Patrick, Bushnell, & Martin, 2000) This 26-item self-report measure examines current (past two weeks) quality of life in four domains: physical health (e.g., "How well are you able to get around?"), psychological health(e.g., "To what extent do you feel your life to be meaningful?"), social relationships (e.g., "How satisfied are you with your personal relationships?"), and environmental factors (e.g., "Have you enough money to meet your needs?"). Single additional items tap general QOL (e.g., "How would you rate your quality of life?") and general health (e.g., "How satisfied are you with your health?") and are included in the total QOL score. Domain item responses are on a five-point scale (*Not at all* to *Extremely)*; items are summed to achieve raw domain scores, with higher scores indicating better perceived QOL. Prior research suggests that internal consistency of the WHOQOL-BREF domain subscales is satisfactory (Cronbach's alpha coefficients > .7; Huang, Wu, & Frangakis, 2006). For the current sample, an abbreviated, 19-item version of the WHOQOL-BREF scales was employed due to missing data in the first cohort. The social QOL scale (three items) was administered to the second cohort, only; therefore this domain is examined

only in that cohort and is not included in the total QOL score for the sample, as a whole. Missing data in the first cohort also included three items from the environmental QOL scale and one item from the psychological QOL scale. As a result, the psychological QOL scale was shortened to four items and the environmental scale to five items, while the physical QOL scale maintained its original seven items. Correlations between the abbreviated and full versions of the scales, using data from the second cohort, will be reported in the results section. Internal reliability for all scales on the abbreviated 19-item version of the WHOQOL-BREF, used in this study, were adequate, $\alpha = .63$ (Physical), .78 (Psychological), .68 (Social), and .73 (Environmental).

Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). This frequently used measure consists of 10 items designed to assess the degree to which common life situations are deemed stressful, referencing the past month (e.g., "In the last month, how often have you been upset because of something that happened unexpectedly?"). Responses are made on a five-point scale (0 = *never*, 4 = *very often*). The PSS has previously been shown to have high internal reliability ($\alpha = .85$) and to positively correlate with physical symptoms of anxiety (Cohen et al., 1983); using data from the second cohort of the current study ($n = 510$), internal reliability of the scale was determined to be similarly high ($\alpha = .88$). Scoring of a paper-and-pencil version of the PSS, utilized for the first cohort, was such that individual item-level data is unavailable for that subsample.

Brief Symptom Inventory (BSI; Derogatis, 1993). This commonly used, 53-item, self-report measure consists of nine scales and three global indices designed to assess presence and severity of a variety of psychological symptoms (e.g., Depression, Anxiety). Examples include: "Thoughts of ending your life," "Feelings of worthlessness" (depression symptoms),

"Feeling fearful," and "Nervousness or shakiness inside" (anxiety symptoms). Symptoms are assessed by frequency or severity of symptom experience on a five-point Likert-type scale (0= *Not at all*, 4= *Extremely*). The BSI has satisfactory reliability. Internal consistency reliability for the depression and anxiety scales are .85 and .81, respectively, while test-retest reliabilities are .84 and .79 respectively (Derogatis, 1993). The predictive validity of the BSI has also been accepted as satisfactory, with a correlation of .95 between both the BSI Depression and Anxiety scales and the Symptom Checklist -90 (SCL-90) Depression and Anxiety subscales (Derogatis, 1993). Coefficient alphas were derived for the six-item Depression and Anxiety scales used in the current sample, and were similarly adequate (.87 and .78, respectively).

Data Analytic Strategy

Initial analyses included MANOVA comparisons of the fall and spring participant cohorts examining both independent and dependent variables to ensure statistical equivalence before combining into one sample for subsequent analyses. The primary empirical data were analyzed through a series of hierarchical multiple regressions using nine predictor variables, entered in three blocks as follows: Block One: age, gender (coded: male = 1, female = 2), and education level; Block Two: BSI Depression scale and BSI Anxiety scale; Block Three: ADHD inattentive symptoms (IA), ADHD hyperactive-impulsive symptoms (HI), ADHD Sluggish Cognitive Tempo symptoms (SCT), and Barkley and colleagues' (2008) adult ADHD criteria (B-ADHD). The use of three predictor blocks maximizes power for variables in each block; concrete hypotheses (i.e., that ADHD symptoms will negatively relate to QOL indices and be positively associated with perceived stress) are tested in the third block. Statistically significant ADHD-related predictors in the third block, implicitly, contribute to

risk for negative outcomes over and above demographic makeup and other psychopathology. Six separate regressions were run to examine prediction of the following dependent variables: five quality of life indices (total score and physical, psychological, social, and environmental subdomains), and perceived stress scale score. As noted previously, the social QOL analysis included only half of the sample, resulting in lower statistical power.

Other supplementary analyses (e.g., item-level regressions, effect size calculations) were employed *post-hoc* to further examine interesting trends and answer research questions emerging from the primary regression analyses.

Results

As indicated above, MANOVAs were employed to determine if differences existed between the spring and fall cohorts on both independent, Wilks' Lambda, $\Lambda = .98$, $F\ (8, 932) = 2.31$, $p = .02$, and dependent variables, $\Lambda = .43$, $F\ (5, 975) = 256.82$, $p < .001$. Follow-up analyses indicated that the cohorts are statistically different from one another on age (an IV already included in block one of the regression model), total QOL, and perceived stress (PS), with cohort one displaying higher total QOL and cohort two higher overall age and PS. In order to exert some statistical control for potential cohort differences, a dichotomous "dummy" variable corresponding to cohort number (coded as 1 or 2) was included in the first block of indicated regression equations (i.e., for total QOL, PS), allowing for independent ascertainment of variance accounted for by other predictor variables.

The versions of the psychological and environmental QOL scales used in the analyses were shortened from their original form (see description in Measures section). Correlational analyses indicated that the shortened form of both psychological QOL and environmental

QOL subscales are significantly and positively correlated with the original, longer version of each scale (*r*s = .86 and .80, respectively, $p < .01$, as calculated using data from cohort two).

Six hierarchical multiple regressions were conducted, as planned (see above). General results from these analyses are noted in Tables 3 through 8 and are discussed further below.

In the first regression predicting overall QOL, each of the three hierarchical steps added statistically significant predictive power, as noted in Table 3. The final model predicted 42% of the variance, with cohort (standardized beta, β = -.30), depression (β = -.29), and inattention (β = -.20) serving as strong predictors of lower levels of total QOL. Education (β =.17) and SCT (β = -.16) were also significant predictors.

Each of the three hierarchical steps in the second regression, which examined physical QOL, also added statistically significant predictive power, as noted in Table 4. The final model predicted 15% of the variance, with SCT (β = -.16), age (β = -.16),depression (β = -.15), education (β = .10), and HI (β = -.09) serving as significant predictors in this model.

As for psychological QOL, again, each hierarchical step added meaningful predictive power (see Table 3), with the final model predicting 35% of the variance. Depression (β = -.39), IA (β = -.20), SCT (β = -.15), education (β = .10), and gender (β = -.09) were all significant predictors (see Table 5).

In the fourth regression examining social QOL in the second cohort, the second and third hierarchical steps added statistically significant predictive power, as noted in Table 6. The final model predicted 5% of the variance, with depression emerging as the only significant predictor (β = -.18).

In examining predictors of environmental QOL, all of the hierarchical steps added statistically significant predictive power (See Table 7). The final model predicted 22% of the variance. Depression emerged as a strong significant predictor (β = -.24) for environmental QOL, while education and age (β = .21 and β = .09) were significant predictors, as well. No ADHD variable served as a statistically significant predictor for environmental QOL.

As with the majority of the previous analyses, each of the three hierarchical steps in the final regression on perceived stress added statistically significant predictive power (see Table 8). The final model predicted 43% of the variance with depression (β = .26), IA (β = .24), cohort (β = .15), anxiety (β = .15),SCT (β = .12), education (β = -.08), gender (β = .08), and age (β = -.07) serving as significant predictors.

Exploratory Analyses

In order to further examine select, possible relationships between ADHD predictors and specific QOL scales, item-level regressions were employed *post-hoc*.

IA and social quality of life. Hierarchical multiple regressions using two predictor variables, entered in two blocks (Block One: ADHD IA; Block Two: BSI Depression), were utilized to further determine the relationship of IA to social QOL, as well as to each item on this QOL domain scale. Depression served as the only significant predictor of social QOL in the primary analyses; thus, it was included in the exploratory analyses to determine if the effects of IA were, in effect, "overridden" by the presence of depressive symptoms. Both hierarchical steps added statistically significant predictive power. The final model predicted 4.5% of the variance, with both depression (ß = -.16) and IA (ß = -.11) serving as significant predictors of lower levels of social QOL. In an examination of associations between IA and specific items on the social QOL scale, IA significantly predicted satisfaction with personal

relationships (β = -.20), sexual satisfaction (β = -.18), and satisfaction with social support (β = -.16), even when depression is included in the analyses (see Table 9).

HI and physical quality of life. In item-level regressions examining the association of HI and each physical QOL item, HI significantly predicted energy level (β = -.29), sleep satisfaction (β = -.24), ability to perform daily activities (β = -.20), capacity for work (β = -.19), and mobility (β = -.12; see Table 10).

SCT and physical quality of life. An examination of associations between SCT and specific items on the physical QOL scale indicate SCT to significantly predict energy level (β = -.46), capacity for work (β = -.34), ability to perform daily activities (β = -.32), sleep satisfaction (β = -.29), and mobility (β = -.18) in this adult population (see Table 9).

SCT and psychological quality of life. Exploratory analyses of the predictive powers of SCT on items in the psychological QOL scale demonstrate SCT as a significant predictor for *every* item on the psychological QOL subscale: ability to concentrate (β = -.46), self-satisfaction (β = -.35), body acceptance (β = -.28), enjoyment of life (β = -.27), and meaningfulness of life (β = -.22; see Table 9).

SCT and environmental quality of life. Post-hoc regression analyses were also employed on each environmental QOL item in an attempt to specify the possible relationship between SCT and environmental QOL. SCT served as a significant predictor of *every* aspect of environmental QOL: perceived healthiness of the physical environment (β = -.24), financial status (β = -.23), opportunity for leisure activities (β = -.22), perceived safety in daily life (β = -.19), and availability of informational resources (β = -.16; see Table 9).

Discussion

Overall, these results indicate that the specific dimensions of ADHD symptomatology influence quality of life and perceived stress, and, importantly, that their influence is substantial even when taking potential demographic differences and depression and anxiety—two common comorbidities to ADHD—into consideration. Elaboration regarding the predictive power of various ADHD characteristics on aspects of QOL and PSS follows.

Consistent with stated hypotheses, ADHD symptoms tended to be negatively associated with QOL variables and to positively correlate with perceived stress. However, while IA and SCT were fairly consistent predictors, HI symptoms predicted only one QOL variable.

Inattention: Discussion of Findings

IA and psychological quality of life. Inattention appears to be strongly related to lower psychological QOL. Ratings on this domain scale tap enjoyment and meaning in life, ability to concentrate, satisfaction with self and body image, as well as general mood. Ample research suggests that ADHD symptoms are related to increased prevalence of anxiety (Barkley, 2006; Waring & Lapane, 2008), depression (Bohline, 1985; Waring & Lapane, 2008), and other psychological disorders in both children and adults (see review in Barkley, 2006). More specifically, Young and Gudjonsson (2006) emphasize the importance of specifically recognizing the impact of attentional deficits on psychological functioning. Existent research already suggests that children demonstrating IA symptoms tend to be rated by teachers as being significantly more impaired in areas of psychological functioning, including anxiety, depression, withdrawal, somatic complaints, and internalizing behavior (Gaub & Carlson, 1997). Inattention has been more broadly linked to academic (Barkley,

2006; Riley, Spiel et al., 2006) and interpersonal difficulties (Barkley, 2006; Canu & Carlson, 2007; Riley, Spiel et al., 2006) as well as to lower life satisfaction, lower achievement (Riley, Spiel et al., 2006), and vulnerability for the development of low self-esteem and other emotional problems (Barkley, 2006; Waring & Lapane, 2008). It should be noted, finally, that the short version of the psychological QOL subscale employed in this study omitted an item that directly tapped current depression and anxiety, which, perhaps, makes this particular finding even more significant, as it suggests a broader impact of IA on psychological functioning.

IA and environmental quality of life. The environmental QOL subscale includes items assessing perceived safety of the physical environment, satisfaction with living conditions and transportation, the availability of informational resources and health provision, and personal income. Other QOL subdomain scales contain items more theoretically relevant to ADHD and mental health, whereas the items on the environmental QOL scale do not appear so obviously connected, which is made more evident by the fact that core ADHD traits did not significantly predict overall scale scores. However, IA (ß = -.088), SCT (ß = -.081), and B-ADHD (ß = -.067) all demonstrate a trend ($.05 < p < .10$) toward predicting lower levels of environmental QOL. Further, statistically significant and negative two-tailed Pearson correlations were noted between each environmental QOL item and each ADHD variable (IA, HI, SCT, and B-ADHD), although these were quite modest in size (*r*s from .11 to .24).

One possible explanation for this weak association between ADHD and environmental QOL lies in the well-established link between IA and HI and educational (Barkley, 2006; DuPaul, 1991; McDonald-Richard, 1995; Reardon & Nagliery, 1992; Reaser

et al., 2007), vocational (Weiss et al., 1993), and income disparity (i.e., wage earnings; Barkley, 2006). In this study, education positively predicted environmental QOL (further discussion below). Given the likelihood that individuals in our sample who are at the high end of the ADHD IA and HI spectrum suffer some educational impairment, the effect of ADHD symptoms *over and above* such negative, ADHD-related *impairment* (i.e., lower educational attainment) might, indeed, not reasonably be expected to reach statistical significance. In other words, the educational "glass ceiling" experienced by those with clinical levels of ADHD may mediate any relationship between ADHD and satisfaction with physical surroundings (e.g., housing, transportation, access to medical care).

Indeed, when considering environmental QOL, the beta for education is higher than it is for other outcome variables, adding support to the conclusion that education is more strongly associated with this outcome than IA or other ADHD variables. However, it is important to note that, although this sample's prevalence of elevated ADHD traits is comparable to national norms (4.38% of the sample with elevated IA and 1.32% with elevated HI traits vs. 4.4% of adults meeting criteria for ADHD in the generalized population; Kessler et al., 2006), the education level of the sample is much higher than would be expected of the general population. In this sample, 81.6% have attended at least some college, while 2009 national norm data indicates that 19.49% of individuals aged 18 or older have some college and 17.74% have a bachelor's degree (National Center for Education Statistics, n.d.). Perhaps, then, it is *exceptional* levels of education that provide a buffer for negative environmental QOL outcomes. Future research in populations with educational attainment closer to the norm could help clarify the nature of the relationship between these variables.

IA and physical quality of life. Examination of the correspondence of ADHD variables to physical QOL indicates that SCT and HI, but *not* IA, predict lower levels of Physical QOL. Items on this domain scale tapped degree of physical pain experienced, chronic need for medical treatment, energy level, mobility, sleep, capacity for work, and activities of daily living. Extant research indicates that ADHD-specific inattentive behaviors are considered a primary factor in risky driving (Barkley & Cox, 2007; Nada-Raja et al., 1997; Thompson, Molina, Pelham, & Gnagy, 2007) as well as failure to avoid risky behaviors (e.g., activities that threaten health and development or disrupt social environment; Riley, Spiel et al., 2006), suggesting that IA is related to incidence of injury and accident. However, IA may not be predictive of physical QOL, as assessed by this scale, due to the scale's emphasis on physical functioning in daily life and failure of scale items to tap these IA-related vulnerabilities, specifically.

IA and social quality of life. Unexpectedly, results indicate that social QOL is not significantly predicted by any ADHD variable. The social subscale of QOL examines satisfaction in personal relationships. Extant research provides numerous indications that a link exists between adulthood inattention, in particular, and social maladjustment. ADHD-IA children appear to be more often characterized as passive, shy, and socially withdrawn (Wheeler & Carlson, 1994; see review in Henker & Whalen, 1999), and adults with ADHD-IA, in comparison to those with ADHD-C, have an increased risk of social difficulties, as well (Canu & Carlson, 2007). In addition, adults with ADHD-IA have also been characterized as having poor listening skills, a trait that negatively affects social interaction abilities (Murphy & Barkley, 1996). In fact, inattentive behaviors (i.e., not remembering being told things, zoning out in conversations) are most highly endorsed by spouses of men

with ADHD as contributing to marital tension (Robin & Payson, 2002). Obviously, findings of this study contradict this trend. It may be important to note, however, that the power of this analysis, among all the regressions on QOL variables, was substantially lower, given that only one cohort was administered this domain scale, and this may have interfered with the detection of somewhat-less-powerful ADHD predictors. For instance, in the multiple regression on psychological QOL, both education and gender had βs < .1 and were statistically significant predictors, whereas IA (β = -.104) did not meet the standard for significance in the social QOL model.

Additionally, it should be noted that the overall regression equation only minimally predicted variance in social QOL (5%). Perhaps the construct of social QOL, per se, is not fully or even adequately captured by the WHOQOL social QOL items, which only address three general social areas (e.g., relationship satisfaction, sexual satisfaction, and social support). This possibility is also reflected in the relatively low alpha for this scale. However, supplementary analyses demonstrated that IA, specifically, is associated with the aspects of social impairment tapped by the WHOQOL (satisfaction with personal relationships, sexual satisfaction, and satisfaction with social support), regardless of the presence of depression. However, the association of IA with social QOL, in this study, is likely diluted by the inclusion of other predictor variables (see Future Directions for further discussion).

IA and total quality of life. Although only one of the QOL domains, individually, is predicted in this sample by IA, it was negatively related to *overall* QOL. It is possible, therefore, that, as seen in the exploratory analysis for social QOL, sub-components of quality of life in the different domains are substantially predicted by IA. The main findings of this study support prior research showing a tendency for the psychological QOL of individuals

with ADHD to suffer as a result of their symptoms, and especially so for those with the ADHD-IA type (Riley, Spiel et al., 2006). The exploratory analyses further suggest that IA is associated with perceived quality of social experience. As a whole, then, and as previously discussed, these findings fit with extant research indicating that IA can negatively affect academic and work performance, social interactions, psychological functioning, and other domains (Barkley, 2006; Canu & Carlson, 2007; Gaub & Carlson, 1997; Riley, Spiel et al., 2006; Waring & Lapane, 2008). In particular, the current finding that IA predicts lower overall levels of QOL underscores that this cluster of ADHD symptoms is likely to affect adult life satisfaction and functioning.

IA and perceived stress. In this study, inattention was significantly associated with higher levels of perceived stress. Items on the PSS examine an individual's perceived ability to successfully deal with irritating life hassles and personal problems, frequency of feeling upset or overwhelmed, and sense of control in life. Other studies have demonstrated links between ADHD and higher levels of physiological stress (Lackschewitz et al., 2008), although this previous research did not consider the independent contribution of the two primary symptom clusters. ADHD has also been associated with more general stressors, such as financial strain due to medical costs and behavioral interventions (Beitchman et al., 1992; Lange et al., 2005; Riley, Lyman et al., 2006) and some research suggests that individuals with ADHD are less likely to cope effectively in the face of daily stressors (Riley, Spiel et al., 2006). However, previous research has not looked specifically at the perceived level of stress in individuals with prominent ADHD traits. Given research demonstrating individuals with high inattentiveness, in particular, are more likely to experience stressors and to have

lower satisfaction in daily life (Riley, Spiel et al., 2006), the link that these results suggest between inattention and higher levels of stress makes sense.

Hyperactivity-Impulsivity: Discussion of Findings

Interestingly, HI only served as a significant predictor for physical QOL. Prior research suggests that, compared to non-diagnosed peers, those exhibiting ADHD symptoms are much more likely to suffer injury requiring medical attention (Lee, Harrington, Chang, & Connors, 2008; Swensen et al., 2004), and drive dangerously (Barkley, Murphy, Dupaul, & Bush, 2002; Canu, Massey, Tabor, Rowan, & Shook, 2008; Richards, Deffenbacher, & Rosén, 2002). Specifically, HI symptoms have been associated with poor decision making while driving (Barkley, Fischer, Smallish, & Fletcher, 2002), increasing the likelihood of automobile-related accidents. In addition, ADHD symptoms have been related to numerous sleep problems, as these are reported by approximately 83% of adults diagnosed with ADHD (Schredl, Alm, & Sobanski, 2007). Therefore, the finding that HI is predictive of lower levels of physical QOL is consistent with previous research suggesting individuals with these symptoms are at higher risk for conditions and injuries that negatively affect physical functioning.

In order to explore HI's effect on physical QOL more in-depth, *post-hoc* item-level linear regressions were utilized. Results of these regressions add support for the association of HI and lower levels of physical QOL. HI traits are, indeed, negatively associated with specific aspects of physical functioning, including energy level, sleep satisfaction, ability to perform daily activities, capacity for work, and mobility. These findings underscore the observed omnibus result, further demonstrating HI traits to be clearly associated with specific impairments in functioning related to physical QOL.Considering the well-established,

negative impact of ADHD on QOL and stress levels (Barkley, 2006; Canu & Carlson, 2007; Gaub & Carlson, 1997; Riley, Spiel et al., 2006; Waring & Lapane, 2008), it seems quite surprising that HI, at least statistically speaking, had no impact on any other outcome variable. However, the clusters of ADHD symptoms have been differentially associated with child and adult groups within the affected population (Barkley, 1997). HI symptoms, specifically, emerge earlier in life and tend to decrease with age, whereas inattentive symptoms become more prevalent several years later in childhood and tend to endure into adulthood (see review in Barkley, 1997).

Given that the sample used in this study consisted of adults, and recognizing that IA traits are more likely than HI to persist (Nolan et al., 1999; see review in Barkley, 2006), perhaps, in this sample, there was a lower proportion of individuals who truly had impairing levels of HI that would best predict broad impairment. As a follow-up, an examination of the distribution of scores in this sample relative to conservative, published norms for young adults (i.e., + 1.5 *SD* clinical cutoff for 17-29 year old males; Barkley & Murphy, 2006) was implemented in order to determine, as compared to a substantially younger, independent sample (current participants' *M* age = 45.56 years), what the prevalence of persistently elevated HI and IA is. The percentage of individuals in the sample who met these conservative criteria for elevated IA symptoms is 4.4%, while only 1.3% reported elevated HI symptoms, supporting the assumption that HI is less prevalent than IA in later life.[1]

For social QOL, HI's lack of predictive power might be explained by prior research suggesting an improved social experience for adults with elevated HI, over those with ADHD-IA (Canu & Carlson, 2003). Inattentive symptoms, such as deficits in communication, memory, and time management appear related to marital discord (Robin &

Payson, 2002), and young adult males with ADHD-IA typically experience more opposite-sex peer rejection than those with HI included in their symptom presentation (Canu & Carlson, 2003). Although no ADHD symptom significantly predicted social QOL, the trend of the data suggests HI is not as related to poor social QOL as IA is (β = -.02 and β = -.10, respectively). Overall, although there are theoretically-sound explanations for HI's non-association with the majority of the variables examined in this study, its lack of more consistent predictive power remains surprising, given extant research suggesting the symptoms of HI to be impairing in multiple domains of functioning.

Sluggish Cognitive Tempo (SCT): Discussion of Findings

As previously discussed, the relatively newly-conceived trait of SCT has been linked to ADHD-IA in children (Barkley, 2006; Carlson & Mann, 2002). SCT symptoms include sluggishness, drowsiness, confusion, and tendency to daydream or become lost in thought, all of which largely oppose the *DSM-IV-TR* symptoms of HI. In fact, some researchers have suggested that prominent symptoms of SCT may delineate a subtype of the ADHD-IA population (Carlson & Mann, 2002; McBurnett, Pfiffner, & Frick, 2001). In this study, SCT significantly predicts lower levels of physical, psychological, and overall QOL as well as higher levels of perceived stress. Taken with the findings regarding IA's fairly substantial association with QOL and PS, it seems that the presence of both SCT and IA represents a peculiar liability, indeed, and supports the assertion in existent literature (Carlson & Mann, 2002) that an "SCT plus IA" subtype of ADHD exists and is characterized by high symptomatic severity and impairment.

Unfortunately, the literature linking SCT to constructs of QOL and PS is extremely limited. A search of the PSYCINFO database on March 24, 2010, using the search term

"sluggish cognitive tempo" resulted in only 23 articles, 17 of which concentrated on establishing or confirming the association between ADHD-IA and SCT. The remaining published articles on SCT focused on the importance of developing appropriate measures of SCT (n = 2), neuro-cognitive deficits in individuals with the various ADHD types and including SCT (n = 2), linking SCT symptoms to childhood leukemia, and examining the impact of medication on IA and SCT. Only 4 of these 23 articles, all of which utilized samples of children, referenced any life outcomes or difficulties relevant to QOL or PS; relevant findings from these are incorporated in the discussion below. Thus, the current finding of a robust relationship between SCT and QOL and PS in adulthood is novel.

Without the context of previous research to aid interpretation of these findings, *post-hoc* analysis seemed desirable. This was especially true for QOL, given the broad spectrum of behaviors and other outcomes that are tapped. Accordingly, linear regression analyses were used to examine how SCT related to the individual WHOQOL items. These are discussed below, ancillary to discussion of the initial multiple regression analyses examining domain-level data.

SCT and physical quality of life. The current findings show SCT to negatively predict physical QOL. The sluggishness, confusion and lack of awareness (Carlson & Mann, 2002) associated with SCT could all affect one's perception of physical well-being. SCT may also be related to other physical concerns. For instance, children with SCT symptoms have tended to report more physical and somatic complaints to teachers than children with ADHD-C or without ADHD (Carlson & Mann, 2002).

The commonly experienced negative physical consequences of ADHD in childhood may constitute a chronic liability for adults with persistent symptoms, as well. Exploratory

analyses indicated that SCT is, indeed, linked to endorsement of specific physical impairments in this adult population, including energy level, capacity for work , ability to perform daily activities, sleep satisfaction, and mobility. Several studies have associated adult ADHD with reduced quantity and quality of sleep (Philipsen, Hornyak, & Riemann, 2006; Schredl et al., 2007; Sobanski et al., 2008) and occupational difficulties (Barkley, 2006; Laaksonen et al., 2005; Weiss et al., 1993). Results of this study coincide with these findings and extend the understanding of the relationship of SCT to physical functioning throughout the day.

SCT and psychological quality of life. SCT also negatively predicted subjective psychological well-being. This finding fits with a small body of prior research showing that children with SCT symptoms tend to display more internalizing (e.g., unhappiness, anxiety, depression) and fewer externalizing (e.g., hyperactivity, oppositional behavior) problems (see review in Barkley, 2006). For instance, in a study by Carlson and Mann (2002), children with high SCT and IA were rated by teachers as being less happy, more anxious and depressed, and more likely to display symptoms of social withdrawal. In addition, some research suggests that individuals with SCT have specific difficulties with information processing, focused attention, and memory retrieval (Milich, Ballentine, & Lynam 2001).

Exploratory item-level regressions were employed to further examine the impact of SCT and psychological functioning and showed SCT to negatively impact *every* item on the psychological QOL subscale: ability to concentrate, self-satisfaction, body acceptance, enjoyment of life, and meaningfulness of life. The finding that SCT negatively impacts ability to concentrate is not surprising, given SCT's association with IA and the manifestation of SCT itself. SCT is linked here to enjoyment and meaningfulness of life,

supporting previous findings suggesting individuals with prominent ADHD symptoms experience significant impairment and frustration in a variety of life domains (e.g., academic/occupational, interpersonal, emotional; Barkley, 2006; Riley, Spiel et al., 2006). Associations between SCT, body acceptance, and self-satisfaction also coincide with extant research linking ADHD to poor self-esteem (APA, 2000; Canu & Carlson, 2003). Previous discussion demonstrates the risk of individuals with IA to experience poor psychological QOL (see above). Findings on SCT emphasize this vulnerability, suggesting that the presence of SCT symptoms, in addition to IA, increase that risk further.

SCT and social quality of life. As mentioned above, no ADHD variable significantly predicted social QOL. Although previous research indicates that SCT symptoms are associated with social withdrawal and other negative social outcomes in children (Carlson & Mann, 2002; Mikami, Huang-Pollock, Pfiffner, McBurnett, & Hangai, 2007; see review in Barkley, 2006), findings from this study suggest that SCT does not predict poorer social QOL in adulthood. As previously mentioned, studies linking SCT with adult life outcomes are sparse. Previous discussion of exploratory IA analyses indicates that IA is associated with social impairment and previous research has demonstrated that IA individuals perceive less support from friends and actually spend less time in close contact with friends than do individuals with HI or no ADHD symptoms (Canu & Carlson, 2007). Therefore, SCT, as an indicator of a putatively more-severe subtype of IA, would logically also predict such outcomes. Although the results of this study do not suggest such impairment for adults with SCT, future research should explore this possible link further in order to determine if individuals with ADHD-IA, and especially those with additional symptoms of SCT, may be at particular risk for social dissatisfaction.

SCT and environmental quality of life. As previously mentioned, no ADHD variable significantly predicted environmental QOL, yet there was a trend towards significance (β = -.08; $p < .10$) in SCT's ability to predict this domain. Prior research on SCT and its impact on satisfaction with and perception of aspects of the physical environment is more limited than research linking SCT to other domains. Hypothetically, SCT's impact on capacity for work and social satisfaction likely influences aspects of environmental QOL (e.g., occupational status, perceived availability of social activities), but no studies have examined these links directly and the findings of this study do not clearly support that assumption.

Post-hoc regression analyses were employed on each environmental QOL item in an attempt to specify the possible relationship between SCT and perceived quality of one's community and living situation. SCT appears to be negatively associated with *every* aspect of environmental QOL: perceived healthiness of the physical environment, financial status, opportunity for leisure activities, perceived safety in daily life, and availability of informational resources. Aforementioned research suggests that individuals with ADHD tend to hold lower status occupations (Weiss et al.,1993) and have lower general SES (Barkley, 2006), which reflects financial hardship in comparison to the non-diagnosed population. Here, SCT, as a putative subset of ADHD symptoms, appears to also be related to occupational and financial difficulty (i.e., resources scarcity). ADHD has also been associated with problematic choices and behaviors that can have long-term effects on health (Lambert & Hartsough, 1998; Murphy & Barkley, 1996; Whalen et al., 2002; Whalen et al., 2003), including poor diet (Davis et al., 2006). The findings of post-hoc analyses suggest that symptoms of SCT may further reduce the likelihood of an individual earning adequate

income, which, in particular, may be the gateway to access of leisure and comfortable, safe living arrangements.

SCT and total quality of life. Previously highlighted are the findings that SCT appears to strongly predict physical and psychological QOL (*ß*s = -.16, -.15, respectively) and has a tenuous relationship with environmental QOL, as well. Understandably, SCT was strongly negatively associated with total QOL. Although research directly linking SCT to QOL variables is limited, there do appear to be findings emphasizing the negative impact that SCT symptoms may have on an individual's somatization, mood, and social satisfaction, all aspects of overall QOL, and the current findings seem to clearly converge with this existent trend in the literature.

SCT and Perceived Stress. SCT also significantly predicted higher levels of perceived stress. Given the numerous associations between ADHD and stress (Beitchman et al., 1992; Lange et al., 2005; Riley, Spiel et al., 2006; Lackschewitz et al., 2008) and the link between IA and stress, in particular (see above), this finding is not surprising. The recognized symptoms of SCT (e.g., sluggishness, drowsiness, confusion, daydreaming) are unlikely to be associated with high intensity reactions to stress, but may affect perceived ability to cope with and respond to stressors, a difficulty already recognized for individuals with ADHD, in general, and ADHD-IA, specifically (Riley, Spiel et al., 2006). ADHD traits have been associated with a lack of persistence in response to challenges and failure (Milich, 1994). Individuals with SCT are likely to have an inadequate response to stress, and may therefore develop a kind of "learned helplessness" and diminished attempts to exert control over stressors. Clearly, however, ample room remains for further research to better define the exact relationship between SCT and stress.

Barkley Adult ADHD Criteria Findings

Barkley and colleagues' (2008) adult ADHD criteria, which putatively map onto executive dysfunction, did not significantly predict any QOL domain or PS. The items included in these six newly-identified adult-ADHD symptoms (e.g., ineffectively inhibiting responses, exercising poor judgment, failing to deploying attention selectively, not adhering to directions) do overlap, to a degree, with impairment that is traditionally characteristic of HI and, particularly, IA. Considering the aforementioned, negative links between inattentive symptoms, QOL, and PS, it would seem reasonable for B-ADHD to have some significant impact on the dependent variables. However, given that the B-ADHD score may overlap significantly with such *DSM-IV-TR* constructs, perhaps its influence is effectively "watered down" when entered simultaneous to HI and IA in a regression model.

Content of the B-ADHD items may also help to explain their non-significance in this study. For example, it would not be expected that completing things out of order or driving faster than others would greatly impact an individual's QOL or PS outcomes. Therefore, these items may effectively indicate ADHD in adulthood (see exception in Fedele, Hartung, Canu & Wilkowski, in press) but not themselves be particularly good at predicting QOL. However, it is important to consider the possibility of B-ADHD criteria's possible relation to other aspects of QOL that were not well captured by the WHOQOL (e.g., stress related to automobile citations and related legal troubles).Future studies will certainly examine the relation of the newly-proposed B-ADHD criteria to various life outcomes and adult domains of adjustment.

QOL and PS associations with internalizing and demographic characteristics

Cohort. Cohort served as a significant predictor for total QOL and perceived stress. Preliminary MANOVA analyses indicated significant differences between the cohorts on both of these variables, cohort one: *M* (*SD*): total QOL = 75.62 (9.18), PS = 12.77 (6.18); cohort two: total QOL = 69.84 (9.14), PS = 14.54 (6.47), providing rationale for including a cohort variable in the primary hierarchical regression analyses. As previously mentioned the entire QOL measure was administered only to cohort two, while only the first 19 items were administered to the first cohort. The scale used in the analyses conforms to the shorter version completed by cohort one, yet, the possibility exists that simply completing a longer version may have impacted cohort two's response style, leading to the cohort differences in total QOL made evident in the preliminary analyses. However, a *post-hoc* regression examining associations between the predictors and the total QOL score calculated with the complete set of WHOQOL items, using data from cohort two, did not reveal any substantial differences in the pattern of associations. In other words, the composition and relative weights of the statistically significant predictor set does not really differ across abbreviated and original total QOL scores, which provides at least some evidence to suggest that length of form was not a substantial contributor to observed cohort differences. . However, a *post-hoc* regression testing whether there were substantial differences in associations between the predictors and the original, full-scale total QOL score, using data from cohort two, did not reveal such a pattern. In fact, the pattern of predictors does not differ when examining cohort two's abbreviated total QOL score or original, full total QOL score.

Similarly, the fact that one cohort completed the PSS on the computer while the other was administered the scale via paper and pencil, may have contributed to the cohort

differences on PS. Research suggests that the form in which a measure is administered (e.g., paper and pencil versus computer administration) may, indeed, impact participants' scores (Keng, McClarty, & Davis, 2008; O'Halloran et al., 2008). As unlikely as it seems that such small variations in form could substantially affect scores, no further reasons for differences between cohorts on total QOL and PS are readily apparent. However, it should be noted that the magnitude of the difference between cohorts on both the PSS and Total QOL scores small to moderate in size (d = 0.28 and 0.63, respectively).

Depression. Depression emerged as a robust, negative predictor for all four QOL domains, overall QOL, and perceived stress. Individuals with depression experience numerous physical symptoms including fatigue, lower energy levels, aches and pains, as well as decreased motivation to be active (APA, 2000). Further, depression and depressive symptoms have been linked to worse perceived health status and physical functioning, as well as greater bodily pain (Carta et al., 2008). Depression's association with poor physical QOL in this study supports these previous findings by indicating that depression, indeed, has negative physical effects.

Given that prototypical symptoms of depression (e.g., difficulty concentrating, feelings of worthlessness, emotional instability; APA, 2000) have obvious impacts on psychological wellness, it is not surprising that they were negatively associated with psychological QOL in this study. Depression has been linked to cognitive dysfunction, life dissatisfaction (Van der Weele, Gussekloo, De Waal, De Craen, & Van der Mast, 2009), and difficulties in role functioning (Carta et al., 2008), all likely components of psychological QOL.

An individual with depression commonly experiences decreases in social involvement and satisfaction (APA, 2000), as well as increases in social loneliness (Van der Weele et al., 2009), which helps to explain the association between depression and lower levels of social QOL in this study. The negative impact that depression has on physical and cognitive functioning likely plays a role in the depressed individual's aversion, reluctance, or perceived inability to socially engage with others, dampening overall social satisfaction. This study's findings support extant research documenting social impairment as a symptom commonly associated with depression.

Depression also negatively predicted environmental QOL. Depression sufferers often have a skewed and negative interpretation of themselves, others, and their overall environment (Beck, Rush, Shaw, & Emery, 1979) and environmentally-related, negative life events have been associated with the development of depressive symptoms (Middledorp, Cath, Beem, Willemsen, & Boomsma, 2008). The link seen in the current study between depression and environmental QOL as well as the other aforementioned QOL domains adds to extant research documenting the negative effects of depression on an individual's ability to function effectively.

Depression also significantly predicts higher perceived stress in this sample, contributing another point of evidence to the converging findings that stress and depression are linked, and often exacerbate one another (Regier, Rae, Narrow, Kaelber, & Schatzberg, 1998; U.S. Department of Health and Human Services, 2000). Extant research demonstrating that depressive symptoms impact the process of worrying (Salzer, Stiller, Tacke-Pook, Jacobi, & Leibing, 2009) also seems in line with this result.

Anxiety. The only variable for which anxiety had significant predictive power was perceived stress, with higher anxiety being associated with higher of perceived stress. This is to be expected, as the terms stress and anxiety tend to be used interchangeably and are often thought to represent elements of a single response system (e.g., Behavioral Activation System), with an ability to recognize and deal with stressors affecting one's level of anxiety (McEwen & Sapolsky, 2006).

However, anxiety did not predict any QOL domain score, despite significant correlations between anxiety and each domain (*r*s from -.14 to -.37). Anxiety's lack of predictive power on the psychological QOL subscale may be explained by the removal of the item directly tapping anxiety when the shorter, 19-item version of the scale was created. However, even when this item is included in the scale (as could be evaluated in the second cohort of the sample), the correlation between anxiety and psychological QOL is quite modest (r = -.190).

Item content of the BSI anxiety scale may also help to explain why scores on this scale did not predict any QOL domain. The items included in this BSI dimension examine nervousness or shakiness inside, feelings of fear, feelings of tension, experiences of panic, and restlessness. These symptoms, as a whole, appear more relevant to experiences of stress than to any particular aspect of QOL, helping to explain anxiety's predictive power for PS and not for QOL.

Age and education. In contrast to other variables, education appears to predict higher levels of physical, psychological, environmental and overall QOL. This finding coincides with research linking well-educated individuals with lower levels of various types of emotional (i.e., depression and anxiety) and physical (i.e., aches and pains) problems (Ross

& VanWilligen, 1997). Individuals with higher levels of education have been shown to experience increased work stability and economic resources (Ross & VanWilligen, 1997), which, in turn, can affect both environmental and overall QOL.

In addition, a possible reason for the unexpected effects of education in this sample may be the characteristics of the sample, itself. The sample is highly educated and many of the individuals in this study classified as having "less education" are likely college students, which changes the value of that description. Given the pattern of results, future research should further examine the potential mediating effects of education when considering the impact of ADHD symptoms on adult life outcomes.

Age, on the other hand, appears to predict lower physical QOL and higher environmental QOL in this sample. As age increases, activity levels tend to decrease, leaving older individuals with lower levels of satisfaction regarding their physical functioning (Hamilton & Carroll, 2004). Additionally, the likelihood of health problems and chronic diseases increases with age. National survey data indicate that approximately 80% of adults 65 years or older have at least one chronic condition, while 50% have at least two (CDC, 2009a). These trends are supported by the findings in this study indicating age as a significant predictor of lower levels of physical QOL. Older individuals have been shown to be more financially satisfied than their younger counterparts (Hansen, Slagsvold, & Moum 2008; Ross & VanWilligen, 1997), a finding supported by the association between age and higher levels of environmental QOL in this study. However, there remains a question of whether this increased financial satisfaction is mainly accounted for by higher likelihood of financial stability in later life or adaptation to and increased acceptance of financial circumstances (Hansen et al., 2008).

Age and education are both significant predictors of lower levels of perceived stress. Considering the increased likelihood of older individuals as well as those with more education to be at a more stable point in their lives (Ross & VanWilligen, 1997), the predictive power of these factors on lower levels of stress is understandable.

Limitations

Although the results of this study are relevant to the theory, diagnosis, and treatment of ADHD and its negative impact on several life outcomes, there are limitations that should be considered when interpreting these findings. Diversity of the sample was limited, consisting of predominantly Caucasian individuals (95.3%). Future research might determine if the findings of this study can be replicated among a more diverse sample. In addition, the study relied on a non-clinical, community sample, using levels of ADHD traits as predictors instead of actual ADHD diagnoses. Therefore, the portion of the sample identified as having elevated ADHD symptoms may include sub-threshold cases of ADHD or even different underlying psychological conditions, as other disorders have symptom profiles that include ADHD-like symptoms, such as hyperactivity (e.g., fidgetiness) in anxiety and inattention (e.g., negative interpretive bias) in depression. However, these two particular, common ADHD comorbidities were included as predictors in this study, which helps to ensure that the effects of ADHD symptoms are not due to the manifestation of these other disorders.

Relatedly, another limitation of this study lies in the high redundancy among predictor variables. Although this redundancy is not unexpected, given the association and overlap among the ADHD variables as well as acknowledged relationships among the ADHD variables and other independent variables (e.g., depression, anxiety, education, age), it does reduce the likelihood of statistical association between these predictors and the

dependent variables. The low tolerance of the ADHD measures in this study (tolerance values: IA = .34; HI = .47; SCT = .42; and Barkley = .55) is considered a potential reason for some of the unexpected non-associations between ADHD variables and QOL outcomes.

For this study, the full social QOL scale was administered to the second cohort, only, limiting the sample size for this particular QOL outcome. In addition, an abbreviated, 19-item version of the physical, psychological, and environmental QOL scales was utilized, corresponding to the items included in the cohort one questionnaire and excluding seven others. Although the shortened and original scales are significantly and positively correlated with one another, these differences in measure construction may have contributed to the predictive power of cohort in predicting total QOL. Additionally, cohort one was administered a paper-and-pencil version of the Perceived Stress Scale, while cohort two completed it online with the other questionnaires. As previously mentioned, MANOVA analyses indicated significant differences between cohorts on this dependent variable, a possible outcome of inconsistent instrumentation in administration.

Another limitation of the study may be the rurality of the sample. All participants lived in or near a small, university town in Western North Carolina. QOL and PS of the sample may be affected by the location in which participants lived, leading one to question whether differential results would have occurred had the sample consisted of participants from both rural and urban backgrounds. Despite the rural nature of the sample, participants' education levels were fairly high, overall, likely reflecting the influence of the relatively large and proximal public university; 21.7% of the sample indicated they had completed four years of college, while 33.6% indicated having completed schooling beyond those four years. The high level of education in this sample, compared to 2009 national data indicating only

17.74% of the population had earned a bachelor's degree (National Center for Education Statistics, n.d.), likely contributed to the power of education to predict aspects of QOL and PS, and also suggests the possibility that those with truly elevated (i.e., > 1.5 *SD* above the mean) ADHD symptomatology are more highly educated and, therefore, better functioning than the norm for those with clinical ADHD diagnoses. This latter possibility, should it be the case, would indicate that added caution should be used when generalizing these findings to the population of adults with ADHD.

To better consider the generalizability of the current findings, an informal examination of the levels of BSI-indexed anxiety and depression in the sample was conducted. A comparison of the *t* score distribution in our sample indicates a similar curve as in the general non-psychiatric population, with SDs approximately at 10 and the means very close to, but slightly above, 50. Although the means and standard deviations are not that different from the norm, a visual examination suggests the distributions are slightly positively skewed. Therefore, the prevalence of anxiety and depression in this sample is comparable to non-psychiatric norms, and lends some confidence to the generalizability of these findings.

Further examination of the generalizability of the findings of this study included informal comparison of PSS scores and WHO-QOL scores of this sample to published norms. The level of perceived stress in the current sample, *M (SD)* = 13.69 (6.39), appears comparable to the young adult norm population for the PSS: Males *M (SD)* = 12.1 (5.9); Females *M (SD)* = 13.7 (6.6; Cohen et al., 1983). Similarly, scores for each of the four QOL domains, when transformed to a 1 to 100 scale (as per the WHOQOL-BREF manual; Bonomi et al., 2000), were also comparable to norms established by Hawthorne, Herman,

and Murphy (2006). Therefore, it appears that the levels of perceived stress and quality of life of the current sample are analogous to that of a more general population, lending some support for the generalizability of current findings.

Additional limitations of the study may be attributed to the methods of recruiting the sample, as well as the nature of data collection. Given that recruitment occurred via advertisement through media and internally on the university campus, the sample may be biased by widespread access to informational resources. Each participant was paid $300 upon completion of the study, which poses another potential problem related to the motivation of participants for accurate reporting. Therefore, a more diverse and less-incented sample might be important for replication of these results.

Although there are notable limitations to the current study that deserve consideration, the sample size and age range of the sample are salient strengths. As previously mentioned, the majority of studies focusing on ADHD life outcomes utilize small samples of children. In fact, it is unknown to the researchers if any previous ADHD study has ever utilized such a broad age-range of adults (18 to 85 years old). Although this study examines ADHD traits as opposed to clinical ADHD diagnoses, the findings in this adult sample that represents practically the full lifespan extend the previously published literature.

Future Directions and Clinical Implications

Perhaps the most notable result of this study is the trend for ADHD-related SCT symptoms to affect quality of life and stress in adulthood. SCT has been predominantly studied in children; therefore, an important direction for future research would be to prospectively follow the impact of SCT on various adult life outcomes. SCT negatively impacts physical, psychological, and overall QOL, as well as perceived stress in this adult

sample. Other research examining these associations is scarce. Therefore, it is important to continue examining SCT in the constellation of putatively associated ADHD symptom groupings, to the specific dysfunctions in adulthood that it predicts. Areas such as energy, sleep satisfaction, physical functioning, mood, information processing, self-esteem, and social satisfaction, as well as financial and environmental hardship, would be appropriate to track to examine whether SCT has more pervasive negative impact.

As previously discussed, a surprising result of this study indicated that IA does not significantly predict social QOL, despite extant research supporting IA as indicative of risk for social rejection and dissatisfaction (Canu & Carlson, 2007; Murphy & Barkley, 1996; Robin & Payson, 2002). Although post-hoc analyses demonstrated IA's associations with aspects of QOL, in this sample, including specific social QOL items, it seems possible that some other related variable or variables may be accounting for variance that normally would be attributed to IA. Further research is necessary to determine and clarify the relationship of IA to social QOL in the presence of other possible predictors (e.g., age, gender, depression, anxiety).

While the most interesting and novel finding of this study is the predictive power of SCT on facets of QOL and stress, the cumulative findings clearly suggest that specific ADHD traits in adulthood impact areas of life satisfaction and adjustment, and contribute to the body of knowledge concerning life outcomes of adults with ADHD, accordingly. In this study, IA and SCT were the main symptomatic predictors—apart from depression—of QOL and perceived stress. It appears that SCT, with IA, has an additive effect for impairment in a number of areas, creating an increased risk for individuals with both types of symptoms to experience negative life outcomes. As SCT is not a component of formal *DSM-IV-TR* ADHD

criteria, it is likely an often unrecognized, and, as it is more associated with the Predominantly IA type, may disproportionately add to dysfunction experienced by individuals with that specific diagnosis. Therefore, incorporating SCT into assessment and research seems very important. As elevated SCT has already been suggested as possibly indicating a subtype of the ADHD-IA population (Carlson & Mann, 2002; McBurnett et al., 2001), further research should also focus on the increased risk of impairment for those with ADHD-IA and SCT. In this study, IA and SCT's robust ability to predict lower levels of some types of QOL and higher levels of perceived stress might suggest that individuals with ADHD-IA and SCT have relatively increased risk of impairment in a variety of areas (e.g., emotional functioning, stress management). These possible outcomes should be examined further in order to determine if ADHD-IA and SCT, indeed, represent a particularly disadvantaged ADHD subtype.

Unfortunately, there does not appear to be an established "best-practice" method to evaluate SCT. In fact, researchers have previously described SCT using a variety of symptoms (e.g., confusion, daydreaming, passivity, hypoactivity, sluggishness, drowsiness; Barkley, 2006; Carlson & Mann, 2002). An important endeavor in future research is to establish a commonly-accepted symptomatic definition of SCT to facilitate accurate and reliable measurement.

In addition to indicating possible areas for future research, findings of this study are also relevant to clinical intervention. In particular, if, indeed, individuals with accurately assessed SCT symptoms exhibit difficulty coping with and responding to stressors, an important intervention for these individuals would likely involve the teaching of stress

management and coping skills. This type of intervention may be especially relevant if future research does indicate the IA plus SCT subtype of ADHD to be at higher risk of impairment.

Notes

1. Distribution descriptives for females in this sample are as follows: IA *M* (*SD*): 5.41 (4.25); Maximum: 26.00; Minimum: 0.00; Skew: positive. HI *M* (*SD*): 5.23 (3.97); Maximum: 27.00; Minimum: 0.00; Skew: positive. Distribution descriptives for males in this sample are as follows: IA *M* (*SD*): 4.71 (3.90); Maximum: 19.00; Minimum: 0.00; Skew: positive. HI *M* (*SD*): 4.41 (3.42); Maximum: 16.00; Minimum: 0.00; Skew: positive.

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Table 1.

Descriptive Statistics: Demographic, Independent, and Dependent Variables

Variable	Mean	Standard Deviation
Age	45.56 years old	16.19
Gender	60.7% female	
Education	15.53 years	2.8
Depression	52.35	10.09
Anxiety	51.21	10.59
IA	5.14	4.13
HI	4.92	3.79
SCT	2.27	1.79
Barkley	3.06	2.53
QOL Total	72.62	9.60
QOL Phys.	28.80	4.16
QOL Psych.	19.25	2.91
QOL Social	11.50	2.16
QOL Envir.	19.50	2.83
PSS	13.69	6.39

Note. IA = DSM-IV Inattention scale score; HI= DSM-IV Hyperactivity/Impulsivity scale score; SCT = Sluggish Cognitive Tempo scale score; PSS = Perceived Stress Scale score

Table 2.

Pearson's Correlations between Independent and Dependent Variables for Entire Sample (both cohorts)

Variables	Age	Gender	Education	Depression	Anxiety	IA	HI	SCT	Barkley	QOL Total	QOL Phys.	QOL Psych.	QOL Social	QOL Envir.	PS
Age	1	0.02	.08*	-0.04	-0.03	-0.04	-.20**	-.16**	-.11**	0	-.10**	0.02	0.01	.14**	-.11**
Gender	0.02	1	-0.01	-0.03	-0.04	.08**	.11**	.09**	-0.05	-0.05	-0.03	-.11**	0.01	-0.01	.09**
Education	.08*	-0.01	1	-0.04	-0.04	0.04	0.02	-.04**	-0.03	.18**	.10**	.11**	0.02	.24**	-.10**
Depression	-0.04	-0.03	-0.04	1	.66*	.37**	.26**	.42**	.30**	-.46**	-.29**	-.51**	-.19**	-.38**	.51**
Anxiety	-0.03	-0.04	-0.04	.66**	1	.38**	.37**	.39**	.31**	-.38**	-.27**	-.36**	-.14**	-.31**	.47**
IA	-0.04	.08**	0.04	.37**	.38**	1	.66**	.72**	.63**	-.40**	-.27**	-.42**	-.16**	-.27**	.50**
HI	-.20**	.11**	0.02	.26**	.37**	.66**	1	.59**	.55**	-.29**	-.23**	-.28**	-.12**	-.22**	.39**
SCT	-.16**	.09**	-0.04	.42**	.39**	.72**	.59**	1	.50**	-.44**	-.30**	-.43**	-.17**	-.30**	.49**
Barkley	-.11**	-.05**	-0.03	.30**	.31**	.63**	.55**	.50**	1	-.29**	-.17**	-.30**	-0.05	-.25**	.39**
QOL Total	0	-0.05	.18**	-.46**	-.38**	-.40**	-.29**	-.44**	-.29**	1	.60**	.83**	.39**	.76**	-.60**
QOL Phys.	-.10**	-0.03	.10**	-.29**	-.27**	-.27**	-.23**	-.30**	-.17**	.60**	1	.48**	.40**	.39**	-.34**
QOL Psych.	0.02	-.11**	.11**	-.51**	-.36**	-.42**	-.28**	-.43**	-.30**	.83**	.48**	1	.38**	.59**	-.57**
QOL Social	0.01	0.01	0.02	-.19**	-.14**	-.16**	-.12**	-.17**	-0.05	.39**	.40**	.38**	1	.28**	-.27**
QOL Envir.	.14**	-0.01	.24**	-.38**	-.31**	-.27**	-.22**	-.30**	-.25**	.76**	.39**	.59**	.28**	1	-.50**
PS	-.11**	0.09	-.10**	.51**	.47**	.50**	.39**	.49**	.39**	-.60**	-.34**	-.57**	-.27**	-.50**	1

Note. **: $p < .01$; *: $p < .05$. IA = Inattention; HI = Hyperactivity Impulsivity, SCT = Sluggish Cognitive Tempo; PS = Perceived Stress

Table 3.

Summary of Hierarchical Regression Predicting Total Quality of Life Scores

Step 1 (Age, Education, Gender, Cohort), $R^2 = .12$, F (4, 929) = 33.21, $p < .001$

Step 2 (Depression, Anxiety), $R^2 = .34$, $\Delta R^2 = .22$, F (2, 927) = 155.92, $p < .001$

Step 3 (ADHD), $R^2 = .42$, $\Delta R^2 = .08$, F (4, 923) = 30.87, $p < .001$

Variable	***B***	***SE B***	**ß**
Age	-.02	.02	-.03
Education	.56	.09	.17***
Gender	-.56	.49	-.03
Cohort	-5.66	.48	-.30***
Depression	-.27	.03	-.29***
Anxiety	-.05	.03	-.05
Inattention	-.45	.10	-.20***
Hyp/Imp	.06	.09	.02
SCT	-.84	.20	-.16***
Barkley	-.01	.13	-.001

Note. ***: $p < .001$; *: $p < .05$. Hyp/Imp = Hyperactivity Impulsivity; SCT = Sluggish Cognitive Tempo.

Table 4.

Summary of Hierarchical Regression Predicting Physical Quality of Life Scores

Step 1 (Age, Education, Gender, Cohort), $R^2 = .02$, $F\ (4, 929) = 5.50$, $p < .001$

Step 2 (Depression, Anxiety), $R^2 = .11$, $\Delta R^2 = .09$, $F\ (2, 927) = 49.54$, $p < .001$

Step 3 (ADHD), $R^2 = .15$, $\Delta R^2 = .05$, $F\ (4, 923) = 12.71$, $p < .001$

Variable	***B***	***SE B***	**ß**
Age	-.04	.01	-.16***
Education	.15	.05	.10**
Gender	.04	.27	.005
Cohort	-.03	.26	-.004
Depression	-.06	.02	-.15***
Anxiety	-.02	.02	-.06
Inattention	-.06	.05	-.06
Hyp/Imp	-.10	.05	-.09*
SCT	-.38	.11	-.16***
Barkley	.09	.07	.06

Note. ***: $p < .001$; **: $p < .01$; *: $p < .05$. Hyp/Imp = Hyperactivity Impulsivity; SCT = Sluggish Cognitive Tempo.

Table 5.

Summary of Hierarchical Regression Predicting Psychological Quality of Life Scores

Step 1 (Age, Education, Gender, Cohort), $R^2 = .02$, F (4, 928) = 5.92, $p < .001$

Step 2 (Depression, Anxiety), $R^2 = .28$, $\Delta R^2 = .26$, F (2, 926) = 165.06, $p < .001$

Step 3 (ADHD), $R^2 = .35$, $\Delta R^2 = .07$, F (4, 922) = 25.15, $p < .001$

Variable	***B***	***SE B***	**ß**
Age	-.004	.01	-.02
Education	.10	.03	.10***
Gender	-.53	.16	-.09**
Cohort	-.21	.16	-.04
Depression	-.11	.01	-.39***
Anxiety	-.01	.01	-.02
Inattention	-.14	.03	-.20***
Hyp/Imp	.03	.03	.04
SCT	-.25	.07	-.15***
Barkley	-.02	.04	-.02

Note. ***: $p < .001$; **: $p < .01$; *: $p < .05$. Hyp/Imp = Hyperactivity Impulsivity, SCT = Sluggish Cognitive Tempo.

Table 6.

Summary of Hierarchical Regression Predicting Social Quality of Life Scores in Cohort 2

Step 1 (Age, Education, Gender), $R^2 = -.01$, $F\ (3, 474) = .24$, $p = .87$

Step 2 (Depression, Anxiety), $R^2 = .03$, $\Delta R^2 = .04$, $F\ (2, 472) = 9.35$, $p < .001$

Step 3 (ADHD), $R^2 = .05$, $\Delta R^2 = .02$, $F\ (4, 468) = 3.02$, $p < .05$

Variable	***B***	***SE B***	**ß**
Age	-.002	.01	-.01
Education	.03	.04	.04
Gender	.11	.21	.03
Depression	-.04	.01	-.18**
Anxiety	.01	.01	.04
Inattention	-.05	.04	-.10
Hyp/Imp	-.01	.04	-.02
SCT	-.13	.08	-.11
Barkley	.09	.05	.11

Note. ***: $p < .001$; **: $p < .01$; *: $p < .05$. Hyp/Imp = Hyperactivity Impulsivity, SCT = Sluggish Cognitive Tempo.

Table 7.

Summary of Hierarchical Regression Predicting Environmental Quality of Life Scores

Step 1 (Age, Education, Gender, Cohort), $R^2 = .06$, $F\ (4, 928) = 16.69$, $p < .001$

Step 2 (Depression, Anxiety), $R^2 = .20$, $\Delta R^2 = .14$, $F\ (2, 926) = 78.40$, $p < .001$

Step 3 (ADHD), $R^2 = .22$, $\Delta R^2 = .03$, $F\ (4, 922) = 8.58$, $p < .001$

Variable	***B***	***SE B***	**ß**
Age	.02	.01	.09**
Education	.21	.03	.21***
Gender	-.05	.17	-.01
Cohort	.06	.17	.01
Depression	-.07	.01	-.24***
Anxiety	-.01	.01	-.05
Inattention	-.06	.03	-.09†
Hyp/Imp	.01	.03	.02
SCT	-.13	.07	-.08†
Barkley	-.08	.04	-.07†

Note. ***: $p < .001$; **: $p < .01$; *: $p < .05$; †: $p < .10$. Hyp/Imp = Hyperactivity Impulsivity, SCT = Sluggish Cognitive Tempo.

Table 8.

Summary of Hierarchical Regression Predicting Perceived Stress Scores

Step 1 (Age, Education, Gender, Cohort), $R^2 = .05$, $F\ (4, 929) = 13.10$, $p < .001$

Step 2 (Depression, Anxiety), $R^2 = .34$, $\Delta R^2 = .29$, $F\ (2, 927) = 200.57$, $p < .001$

Step 3 (ADHD), $R^2 = .43$, $\Delta R^2 = .10$, $F\ (4, 923) = 40.23$, $p < .001$

Variable	***B***	***SE B***	**ß**
Age	-.03	.01	-.07**
Education	-.19	.06	-.08**
Gender	1.09	.33	.08**
Cohort	1.96	.32	.15***
Depression	.16	.02	.26***
Anxiety	.09	.02	.15***
Inattention	.38	.07	.24***
Hyp/Imp	-.02	.06	-.01
SCT	.43	.14	.12**
Barkley	.10	.09	.04

Note. ***: $p < .001$; **: $p < .01$; *: $p < .05$. Hyp/Imp = Hyperactivity Impulsivity; SCT = Sluggish Cognitive Tempo.

Table 9.

Linear regression analyses of Inattention (IA) and Sluggish Cognitive Tempo (SCT) on World Health Organization Quality of Life (QOL) items

QOL Scale Items		IA			SCT	
Physical QOL	***B***	***SE B***	**β**	***B***	***SE B***	**β**
Q3. To what extent do you feel that physical pain prevents you from doing what you need to do?	n/a	n/a	n/a	-.02	.03	-.02
Q4. How much do you need any medical treatment to function in your daily life?	n/a	n/a	n/a	.001	.03	.001
Q10. Do you have enough energy for everyday life?	n/a	n/a	n/a	-.22	.01	-.46***
Q15. How well are you able to get around?	n/a	n/a	n/a	-.07	.01	-.18***
Q16. How satisfied are you with your sleep?	n/a	n/a	n/a	-.17	.02	-.29***
Q17. How satisfied are you with your ability to perform your daily living activities?	n/a	n/a	n/a	-.14	.01	-.32***
Q18. How satisfied are you with your capacity for work?	n/a	n/a	n/a	-.16	.01	-.34***
		IA			SCT	
Psychological QOL	***B***	***SE B***	**β**	***B***	***SE B***	**β**
Q5. How much do you enjoy life?	n/a	n/a	n/a	-.11	.01	-.27***
Q6. To what extent do you feel your life to be meaningful?	n/a	n/a	n/a	-.10	.01	-.22***
Q7. How well are you able to	n/a	n/a	n/a	-.19	.01	-.46***

concentrate?						
Q11. Are you able to accept your bodily appearance?	n/a	n/a	n/a	-.14	.02	-.28***
Q19. How satisfied are you with yourself?	n/a	n/a	n/a	-.16	.01	-.35***
		IA			SCT	
Social QOL	***B***	***SE B***	**β**	***B***	***SE B***	**β**
Q20. How satisfied are you with your personal relationships?	-.04	.01	-.20***	n/a	n/a	n/a
Q21. How satisfied are you with your sex life?	-.04	.01	-.18***	n/a	n/a	n/a
Q22. How satisfied are you with the support you get from your friends?	-.03	.01	-.16***	n/a	n/a	n/a
		IA			SCT	
Environmental QOL	***B***	***SE B***	**β**	***B***	***SE B***	**β**
Q8. How safe do you feel in your daily life?	n/a	n/a	n/a	-.07	.01	-.19***
Q9. How healthy is your physical environment?	n/a	n/a	n/a	-.10	.01	-.24***
Q12. Have you enough money to meet your needs?	n/a	n/a	n/a	-.14	.02	-.23***
Q13. How available to you is the information that you need in your day-to-day life?	n/a	n/a	n/a	-.06	.01	-.16***
Q14. To what extent do you have the opportunity for leisure activities?	n/a	n/a	n/a	-.11	.02	-.22***

Note. ***: $p < .001$; *: $p < .05$. IA = Inattention; SCT = Sluggish Cognitive Tempo.

Table 10.

Linear Regression Analyses of Hyperactivity/Impulsivity on Physical Quality of Life Items

Physical QOL Scale Items	***B***	***SE B***	**β**
Q3. To what extent do you feel that physical pain prevents you from doing what you need to do?	-.004	.01	-.01
Q4. How much do you need any medical treatment to function in your daily life?	.001	.01	.003
Q10. Do you have enough energy for everyday life?	-.07	.01	-.29***
Q15. How well are you able to get around?	-.02	.01	-.12***
Q16. How satisfied are you with your sleep?	-.07	.01	-.24***
Q17. How satisfied are you with your ability to perform your daily living activities?	-.04	.01	-.20***
Q18. How satisfied are you with your capacity for work?	-.04	.01	-.19***

***Note.* ***: $p < .001$.**

Appendix A

Institutional Review Board (IRB) Approval

To: Will Canu
Psychology
CAMPUS MAIL

From: Jay W. Cranston, M.D., Chair, Institutional Review Board

Date: 5/01/2009

RE: Notice of IRB Exemption

Study #: 09-0240
Study Title: Attention-Deficit Hyperactivity Disorder, Stress, and Quality of Life in Adulthood
Exemption Category: (4) Collection or Study of Existing Data

This submission has been reviewed by the above IRB Office and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b). Should you change any aspect of the proposal, you must contact the IRB before implementing the changes to make sure the exempt status will continue. Otherwise, you will not need to apply for annual approval renewal. Please notify the IRB Office when you have completed the study.

CC:
Martha Combs, Psychology

Appendix B

Consent Form for Human Subjects

Quercetin, Upper Respiratory Tract Infection, Inflammation, Mental Vigilance, Blood Lipids, Pharmacokinetics: A Community Clinical Trial

Primary Investigator: David C. Nieman, Dr. PH, Director of the Human Performance Laboratory, Appalachian State University (ASU); niemandc@appstate.edu
Research Project Managers:
Sarah Gross, MS; Melanie Austin, MS
Co-Investigators:
Dru Henson, PhD (immunologist)
Jean-Pierre Kinet, MD (immunologist)
Steven McAnulty, PhD (oxidative stress)
John Quindry, PhD (oxidative stress researcher)
Josh Broman-Fulks, PhD and Will Canu, PhD (psychologists)
Tom Lines (CEO, Quercegen Pharma)

I. PURPOSE OF THIS RESEARCH PROJECT

Quercetin is a unique molecule found in some plant foods such as apples, berries, peppers, black tea, and onions. Quercetin is a powerful antioxidant (5 times more powerful than vitamin C), reduces inflammation, helps regulate the immune system, prevents some types of viruses and bacteria from multiplying, and has caffeine-like effects on the brain. Few studies with humans, however, have been conducted and most of these quercetin-related effects have come from laboratory cell culture and animal studies. Most people ingest about 20 mg of quercetin a day (the equivalent amount found in two large apples). Scientists have shown that people eating high compared to low amounts of quercetin have a reduced risk of developing heart disease, type 2 diabetes, asthma, lung cancer, colorectal cancer, and prostate cancer. In a previous study conducted at Appalachian State University, endurance athletes ingesting large amounts of quercetin (1,000 mg/day for three weeks) experienced improved mental vigilance and reduced illness rates when subjected to stressful amounts of exercise. The primary purpose of this study is to determine if 500 or 1,000 mg quercetin per day compared to placebo during a 12-week period reduced inflammation, oxidative stress, illness, and blood lipids while improving mental function, cognition, and mood.

II. PROCEDURES

One thousand non-institutionalized males and females, 18-75 years of age, will be recruited through mass advertisement in the Boone, NC area. Female subjects must not be or expect to be pregnant or lactating during the study period, January to April, 2008 (and for the second group, September to December, 2008). You must agree to avoid any other supplements containing quercetin. No other restrictions will be placed on diet, supplement usage, or medications, but you will list all current use of supplements and medication in a questionnaire. Subjects with no known disease will randomized to one of three groups: Quercetin-500 (500 mg/day), quercetin-1000 (1000 mg/day), or placebo. Subjects with known diseases (e.g., heart disease, cancer, type 2 diabetes, osteoporosis, arthritis) will be

randomized into one of two groups: Quercetin-1000 or placebo. You will ingest two soft chew supplements twice daily: in the morning after waking, and then again between 2:00 pm and the last meal of the day. This will continue each day during a 12-week period.

You will come to the ASU Human Performance Laboratory (Holmes Convocation Center, Room 054, 111 Rivers Street, Boone, NC; phone 828-262-3142) for two appointments at the beginning and end of the 12-week period. In each of these sessions, you must come to the lab not having consumed food or beverage (other than water) for 9-12 hours, and then provide a blood sample (45 ml or 3 tablespoons). Your resting blood pressure will also be measured. Questionnaires will be administered in both sessions to provide basic demographic and lifestyle habits, and psychological status. The blood samples will be assayed for a wide variety of measures including blood lipids, inflammation indicators such as C-reactive protein (CRP) and cytokines, oxidative stress, and quercetin. These results will be shared with you free-of-charge after the study is completed.

You will start ingesting supplements immediately after the first blood sample and continue for 12 weeks. During the 12-week supplementation period, you will record illness symptoms each day using a validated questionnaire called the Wisconsin Upper Respiratory Symptom Survey. Every four weeks, you will record quality of life measures, gastrointestinal and other health symptoms.

III. RISKS

The amount of blood drawn during each of the two sampling appointments (~45 ml) does not have a negative influence on health. A small amount of bruising at the blood sample site on your arm may be experienced for several days.

Universal precautions will be used throughout all blood sample collections. This refers to a "mindset" or "attitude" taken by the researchers that assumes all blood or body tissues are potentially infectious.

In limited human studies using similar quantities of quercetin supplements, subjects did not experience any measurable adverse effects to their health.

IV. BENEFITS

You will receive results of all tests when they become available. Summaries of the study will be e-mailed and/or mailed to you. This study will help determine if quercetin compared to placebo supplements are effective in improving mental function, cognition and mood, lowering blood lipids, reducing inflammation, reducing oxidative stress, reducing illness, and reducing the incidence and duration or upper respiratory tract infections such as the common cold. You will also receive compensation as described in the compensation section of this consent form. This study is not designed to measure change in disease status for subjects with known disease. Should the experiments notice any changes in disease status, such changes will be shared with the involved subjects.

V. EXTENT OF ANONYMITY AND CONFIDENTIALITY

Your identity will not be disclosed in any published documents or shared with anyone but the experimenters without your express written permission. No mass e-mails will be sent to subjects that display all recipients to everyone. Mass e-mails will be sent by placing the subjects' e-mail addressed in the BCC area. Additionally, the names of participants will not be publicly displayed.

VI. COMPENSATION

Subjects will receive $300 for completing all aspects of the study. If you drop out of the study for any reason, you will be compensated according to the percentage of study requirements completed. For example, if you complete half of the study requirements, you will receive $150.

You may at any time choose to discontinue participation in this study and will not be expected to continue against your will. If as a result of this research project, the investigator determines that you should seek counseling or medical treatment, a list of local services will be provided. In the event of physical injury resulting from the research procedures, immediate first-aid is provided free of charge. No funds have been set aside for medical treatment of any injury or illness resulting from this project.

VII. FREEDOM TO WITHDRAW

You are free to withdraw from this study at any time without penalty subject to the terms described under "compensation" above.

VIII. APPROVAL OF RESEARCH

This research project has been approved, as required, by the Institutional Review Board of Appalachian State University. The investigators have no financial interest in this research project.

IX. SUBJECTS RESPONSIBILITIES

I voluntarily agree to participate in this study. I have the following responsibilities:

1. SUPPLEMENTATION:

a. If you are subject *without known disease*, you agree to be randomized to one of three groups: Quercetin-500 (500 mg/day), quercetin-1000 (1000 mg/day), or placebo.

b. If you are a subject *with known disease*, you agree to be randomized to one of two groups: Quercetin-1000 (1000 mg/day), or placebo.

c. All subjects *agree to avoid any other supplements containing quercetin*. No other restrictions will be placed on diet, supplement usage, or medications, but you will list all current use of supplements and medication in a questionnaire.

d. You will ingest two soft chew supplements twice daily: in the morning after waking, and then again between 2:00pm and the last mean of the day. This will continue each day during a 12-week period.

2. TWO LABORATORY SESSIONS, ASU HUMAN PERFORMANCE LAB:

a. You agree to the ASU Human Performance Laboratory for two appointments at the beginning and end of the 12-week period.

b. In each of these sessions, you agree to come to the lab not having consumed food or beverage (other than water) for 9-12 hours, and then provide a blood sample. You also agree to have your blood pressure measured.

c. In each of these sessions, you agree to fill in questionnaires to provide basic demographic and lifestyle habits. You also agree to have your psychological status and cognition tested using a computerized software package.

3. MONITORING DURING THE 12-WEEK STUDY:

a. During the 12-week supplementation period, you agree to record illness symptoms each day using a validated questionnaire.

b. Every four weeks during the study, you agree to provide answers regarding quality of life measures, gastrointestinal and other healthy symptoms, and other questions brought to your attention by the investigators.

X. SUBJECT'S PERMISSION

I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

_____ Date _____
Subject Signature

_____ Date _____
Subject printed name

_____ Date _____
Witness (optional except for certain classes of subjects)

Should I have any questions about this research or its conduct, I may contact:

David C. Nieman	828-262-6318	niemandc@appstate.edu
Investigator	Telephone	E-mail

Robert L. Johnson	828-262-2692	johnsonrl@appstate.edu
Administrator, IRB	Telephone	E-mail

Graduate Studies & Research
Appalachian State University, Boone, NC 26608

Retain a copy for your records.

Appendix C

Current Symptom Scales

Please choose the answer choice next to each item that best describes your behavior during the past 6 months (for current symptoms).
Answer Choices: *Never or Rarely; Sometimes; Often; Very Often*

ADHD Inattentive Symptoms

- Failed to give close attention to details or make careless mistakes in my work.
- Had difficulty sustaining my attention in tasks or fun activities
- Didn't listen when spoken to directly
- Didn't follow through on instructions and failed to finish work
- Had difficulty organizing tasks and activities
- Avoided, disliked, or was reluctant to engage in work that requires sustained mental effort
- Lost things necessary for tasks or activities.
- Was easily distracted.
- Was forgetful in daily activities.

ADHD Hyperactive/Impulsive Symptoms

- Fidgeted with hands or feet or squirm in seat.
- Left my seat in situation in which sitting is expected.
- Felt restless.
- Had difficulty engaging in leisure activities or doing fun things quietly.
- Felt "on the go" or "driven by a motor."
- Talked excessively.
- Blurted our answers before questions have been completed.
- Had difficulty awaiting turn.
- Interrupted or intruded on others.

Sluggish Cognitive Tempo Items

- Felt confused or "lost in a fog".
- Daydreamed of got lost in my thoughts.
- Felt sluggish or drowsy.

Appendix D

Adult ADHD Criteria

On the following items, rate the behaviors during the past 6 months.
Answer Choices: *Never or Rarely; Sometimes; Often; Very Often*

- Make decisions impulsively.
- Have difficulty stopping activities or behavior when I should do so.
- Start a project or task without reading or listening to directions carefully.
- Show poor follow-through on promises or commitments made to others.
- Have trouble doing things in the proper order or sequence.
- More likely to drive a motor vehicle much faster than others (excessive speeding).

Vita

Martha Combs attended Gainesville High School in Gainesville, Georgia. She graduated summa cum laude with a Bachelor of Science Degree in Psychology from North Georgia College and State University in 2008. She is a member of Phi Kappa Phi, Pi Gamma Mu, and Psi Chi, and received undergraduate recognition at the Student Mentoring Conference for Gerontology and Geriatrics in 2008 for her research involving yoga and body awareness. Her graduate research has focused on health and wellness in the context of Attention-Deficit/Hyperactivity Disorder. Martha has presented research posters in Seattle at the International Society for Research in Child and Adolescent Psychopathology in 2009, New York at the Association for Behavioral and Cognitive Therapies in 2009, and Chattanooga at the Southeastern Psychological Association in 2010.

In fulfillment of program requirements at Appalachian State University, Martha completed a practicum at the Appalachian State University Psychology Clinic and the Appalachian State University Counseling Center. She will complete her internship at the Atlanta Center for Eating Disorders in Atlanta, Georgia, focusing on individual and group therapy and psychological assessments. She plans to pursue a Ph.D. in clinical or counseling psychology and eventually hopes to establish a private practice emphasizing mind and body wellness.