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Impairment, executive function, and symptoms: Understanding ADHD in emerging adulthood

Morgan M. Dorr

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Impairment, executive function, and symptoms: Understanding ADHD in emerging
adulthood

By

Morgan M. Dorr

A Thesis
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Master of Science
in Psychology
in the Department of Psychology.

Mississippi State, Mississippi

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2018

Impairment, executive function, and symptoms: Understanding ADHD in emerging
adulthood

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While Attention-deficit/hyperactivity disorder (ADHD) is one of the most common psychological disorders diagnosed during development, adult ADHD remains vastly under recognized and undertreated. In an effort to better understand current issues with adult ADHD assessment, this study examined the relationship between symptoms, impairment, and executive functioning. Results indicate that among individuals who screened negative for ADHD, those higher in executive function reported experiencing significantly less impairment than those lower in executive function. Executive function was shown to have a negative relationship with impairment and ADHD symptomology was shown to have a positive relationship with impairment. Additionally, impairment was significantly predicted by ADHD symptoms and executive function, and there was a significant interaction between executive function and ADHD symptoms in predicting impairment. Understanding the relationship between executive function, ADHD symptoms, and impairment is critically important in better understanding adult ADHD.

DEDICATION

This thesis is dedicated to my loving wife and parents, without whom this would not have been possible. In addition, this thesis is dedicated to my mentor, Dr. Kevin Armstrong, for providing guidance and support throughout our time together.

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CHAPTER I

INTRODUCTION

Overview

Attention-Deficit/Hyperactivity Disorder (ADHD) is one of the most common psychological disorders diagnosed during childhood. Research indicates that ADHD is a universal phenomenon that is diagnosed more often in boys than girls in all cultures and its expression, associated features, impairments, and outcomes are quite similar wherever it occurs (Faraone, Sergeant, Gillberg, & Biederman, 2003). The *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013) reports that population surveys indicate that ADHD occurs in most cultures in about 5% of children and about 2.5% of adults. Research on ADHD beginning in the mid 1970's and continuing to today has discredited earlier conceptions that the disorder resolved during adolescence and young adulthood, and that ADHD had little or no impact on adult life. Over time, diagnostic criteria for ADHD have changed significantly. Recognizing that previous editions of *DSM* did not provide appropriate guidance to clinicians in diagnosing adults with the condition, the definition of ADHD has been updated in the *DSM-5* to more accurately characterize the experience of affected adults (American Psychiatric Association, 2013).

Impairment and Adult ADHD Through DSM Versions

The essential features of Attention Deficit Disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed.; *DSM-III*; American Psychiatric Association, 1980) are signs of developmentally inappropriate inattention, impulsivity, and hyperactivity. Onset typically occurs by the age of three, academic difficulties are common; and although impairment may be limited to academic functioning, social functioning may be impaired as well (3rd ed.; *DSM-III*; American Psychiatric Association, 1980). The essential features of Attention Deficit Disorder with Hyperactivity are signs of developmentally inappropriate inattention, impulsivity, and hyperactivity and must occur before the age of seven (3rd ed.; *DSM-III*; American Psychiatric Association, 1980). Attention Deficit Disorder without Hyperactivity has the same features as Attention Deficit Disorder with Hyperactivity except for the absence of hyperactivity, and the associated features and impairment are generally milder (3rd ed.; *DSM-III*; American Psychiatric Association, 1980). Diagnostic criteria for Attention Deficit Disorder, Residual Type state that signs of hyperactivity are no longer present but the individual once met criteria for Attention Deficit Disorder with Hyperactivity and that the symptoms of inattention and impulsivity result in some impairment in social or occupational functioning (3rd ed.; *DSM-III*; American Psychiatric Association, 1980).

In the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., rev.; *DSM-III-R*; American Psychiatric Association, 1987), the subtypes of the disorder are collapsed into one category. The *DSM-III-R* (1987) requires 8 of the 14 symptoms listed be present before age 7 for a diagnosis of Attention Deficit Hyperactivity Disorder, and

includes severity criteria (3rd ed., rev.; *DSM-III-R*; American Psychiatric Association, 1987). Mild severity criteria require only minimal or no impairment in school and social functioning, moderate severity criteria require symptoms or functional impairment intermediate between “mild” and “severe,” and severe criteria require significant and pervasive impairment in functioning at home and school and with peers (3rd ed., rev.; *DSM-III-R*; American Psychiatric Association, 1987). Little attention is paid to ADHD in older individuals but the *DSM-III-R* does address some age specific features. Inattention and impulsiveness may contribute to failure to complete assigned tasks or instructions or careless performance on assigned work and excessive fidgeting and restlessness rather than hyperactive symptoms are the most prominent features of ADHD in older children and adolescents (3rd ed., rev.; *DSM-III-R*; American Psychiatric Association, 1987).

The essential feature of Attention deficit Hyperactivity Disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000) is a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequently displayed and more severe than is typically observed in individuals at a comparable level of development. In the *DSM-IV-TR*, some symptoms that cause impairment must have been present before age 7, impairment must be present in at least two settings, and there must be clear evidence of interference with developmentally appropriate social, academic, or occupational functioning for a diagnosis of ADHD (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000). Additionally the *DSM-IV-TR* recognizes that many individuals are diagnosed after

symptoms have been present for a number of years, especially in the case of individuals with Inattentive Type ADHD (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000). The *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) explains that in adolescents and adults, symptoms of hyperactivity take the form of feelings of restlessness and difficulty engaging in quiet sedentary activities and states that in most individuals, symptoms attenuate during late adolescence and adulthood with few experiencing symptoms into mid-adulthood. Both the *DSM-IV* and *DSM-IV-TR* recognize that some adults retain only some symptoms into adulthood, but the *DSM-IV-TR* also cautions against making a diagnosis of ADHD in adults based solely on the basis of the adult's recall because the validity of such retrospective data is often problematic (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000). Changes through these versions of the *DSM* reflect an evolving understanding that ADHD continues to affect individuals into adulthood. The *DSM-5* continues this tradition, making an important and significant changes to criteria for Adult ADHD.

Adult ADHD Diagnosis in the *DSM-5*

Today, a persistent pattern of inattention and or hyperactivity-impulsivity that interferes with functioning or development is the essential diagnostic feature of ADHD, as specified by the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013). Reflecting the current understanding that ADHD may persist throughout the life course, how and when manifestations of the

disorder present are important factors considered in diagnosis. The developmental nature of the symptoms is partially reflected in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013). Diagnostic criteria for ADHD in adults (age 17 and older) are slightly reduced versus individuals under age 17. For the inattention symptom set, ADHD individuals under age 17 must have six or more of the possible nine symptoms to meet diagnostic threshold while adult (age 17 or older) diagnosis requires a minimum of only five. Similarly, there are nine separate symptoms in the hyperactive-impulsive domain and the diagnostic threshold for individuals under 17, is that six or more of the symptoms must be met while the threshold for diagnosis in adults (age 17 or older) requires only five or more symptoms.

Additionally, there are 3 types of ADHD in the *DSM-5*. Combined presentation of ADHD is diagnosed if both inattention and hyperactivity-impulsivity criteria have been met for the past six months. Predominantly inattentive presentation of ADHD requires that only the inattention criterion be met for the past six months and that the hyperactivity-impulsivity criterion is not met. Finally, the predominantly hyperactive-impulsive type of ADHD requires the hyperactive-impulsivity criterion to be met for the past six month but not the inattention criterion. The developmental nature of ADHD is also reflected in other ways. For example, the symptoms related to hyperactivity and impulsivity change across development. The difference in diagnostic criteria as well as the difference between reported ADHD prevalence rates for adults and individuals under 17 years of age reflects current research that has suggested the presentation and symptoms of ADHD differ for adults and non-adults.

Age of Onset

What is now referred to as Attention Deficit/Hyperactivity Disorder, evolved from the diagnosis Hyperkinetic Reaction of Childhood/Adolescence first included in the *Diagnostic and Statistical Manual of Mental Disorders* (2nd ed.; *DSM-II*; American Psychiatric Association, 1968). The *DSM-II* categorized Hyperkinetic Reaction of Childhood/Adolescence as a Behavior Disorder of Childhood and Adolescence, describing it as being characterized by overactivity, restlessness, distractibility, and short attention span, especially in young children and stated that the behavior usually diminishes by adolescence (2nd ed.; *DSM-II*; American Psychiatric Association, 1968). Castellanos (2015) illustrates the continuing influence of how ADHD has been conceptualized historically explaining that a paradigmatic assumption of research on adult ADHD has been that ADHD in affected adults represents the continuation of the childhood condition. This assumption motivated the *DSM-5* ADHD and Disruptive Behavior Disorders Work Group to maintain the tradition of past versions and provide formal criteria for its diagnosis in older adolescents and adults using the same items as are applied in children, asserting that ADHD begins in childhood (Castellanos, 2015). The *DSM-5* continues to conceptualize ADHD as disorder that begins in childhood, and explains that the requirement that several symptoms be present before age 12 is meant to convey the importance of a substantial clinical presentation during childhood (5th ed.; *DSM-5*; American Psychiatric Association, 2013). A potential problem for previously undiagnosed ADHD in adults is that the *DSM-5* states that adult recall of childhood symptoms tends to be unreliable, explaining that it is beneficial to obtain reports from

others (5th ed.; *DSM-5*; American Psychiatric Association, 2013). One potential issue is that this language may prompt clinicians to be suspicious of or even discredit reports of symptoms in childhood by adults seeking an ADHD assessment. Another potential issue is that adults may not be able to provide clinicians with access to individuals that could provide information about the client's behavior in childhood. Additionally, and for a variety of reasons, adults may not want to provide clinicians with access to these individuals, in which case the language and structure of the *DSM-5* may be inadvertently creating assessment climates that could be considered to be coercive by some adults seeking an ADHD assessment. Finally, although the *DSM-5* includes age criteria for symptoms, it does not specify when or if impairment need be present in childhood for adults to receive an ADHD diagnosis.

ADHD Through Development

In general, hyperactive-impulsive symptoms of ADHD are more strongly associated with individuals under age 17. Hyperactive-impulsive ADHD symptoms may appear in children 3 to 4 years old and hyperactivity is the main manifestation of ADHD in preschool. Cognitive and behavioral expressions of ADHD symptoms in toddlers include acting suddenly and without thinking, becoming easily bored, restlessness, talking excessively and reacting strongly and negatively to routine events (Campbell, Shaw, & Gillion, 2000). Frequent characteristics of normal preschool children include poor concentration, high levels of activity, and impulsiveness. Even so, children in this age group with ADHD may still stand out, often displaying poor intensity of play and

excessive motor restlessness, as well as exhibiting patterns of behavior that can continue to impact their lives into childhood, adolescence, and adulthood (Alessandri, 1992; DuPaul, McGoey, Eckert, & VanBrakle, 2001).

The *DSM-5* reports that in adulthood impulsivity may remain problematic along with inattention and restlessness even when hyperactivity has diminished (5th ed.; *DSM-5*; American Psychiatric Association, 2013). Adolescence may bring about a reduction in the overactivity that is often so striking in younger children and the typical signs of hyperactivity that are less common during adolescence (Harpin, 2005), yet impulsiveness and inner restlessness often remain major difficulties. Some symptoms of ADHD appear to decline, but problems resulting from the impact of the symptoms of ADHD on individual development persist and may become worse as deficits influence continuing development. Attention-deficit hyperactivity disorder continues into adolescence for at least 50% or more of clinically referred elementary school children (Spencer, Biederman, & Mick, 2007), and although hyperactive-impulsive symptoms decrease during this time, adolescents with ADHD still display more hyperactive-impulsive symptoms than their peers who do not have the disorder. Consequently, childhood symptoms of hyperactivity-impulsivity are more generally related to poor adolescent outcomes than inattention symptoms (Barkley, 2006b). Those who display a persistent pattern of hyperactive-impulsive and oppositional behavior for at least 1 year are likely to continue on to difficulties into middle childhood and adolescence (Olson, Bates, Sandy, & Lanthier, 2000). However while hyperactive-impulsive behaviors that were present in preschool

continue during elementary school, some symptoms decline from 6 to 12 years of age (Barkley, 2006a).

Although adolescence may bring about a reduction in some symptoms of hyperactive-impulsive type ADHD symptoms such as overactivity, inattention remains a major difficulty (Harpin, 2005). Inattentive ADHD features are more likely to persist into adulthood than hyperactive-impulsive features. Symptoms and related impairments resulting from the persistence of inattentive symptoms include low academic productivity, distractibility, poor organization, trouble meeting deadlines, and an inability to follow through on social promises or commitments to peers (Mash & Wolfe, 2012). These symptoms can affect the developmental process and result in additive effects on individual outcome later in life with or without the persistence of symptoms into adulthood. The combination of severe ADHD-related symptoms and disruptions in the parent-child relationship are especially predictive of continuing ADHD behavior patterns (Campbell, Shaw, & Gilliom, 2000). Despite the fact that ADHD individuals present with more hyperactive-impulsive behaviors when measured and compared with non-ADHD peers, the general decline of some hyperactive symptoms during this developmental period has contributed to a general acceptance that ADHD symptoms would be noticed, and that these symptoms would be causing impairment when sufficient symptomology is present, and that one or both of these would occur before adulthood.

A Lifelong Disorder

Research indicates that most children with ADHD will continue to experience problems, leading to a lifelong pattern of suffering and disappointment (Barkley, Murphy, & Fischer, 2008). The core difficulties in executive function seen in ADHD result in a different picture in later life, depending upon the demands made on the individual by their environment (Harpin, 2005). During primary school years, the child with ADHD may begin to be seen differently, experience academic failure, rejection by peers, and low self esteem more frequently, and experience comorbid problems, such as specific learning difficulties may also begin to impact the child, further complicating diagnosis and management (Harpin, 2005). Additionally, many children with ADHD have very poor sleep patterns, and although they appear not to need much sleep, daytime behavior is often worse when sleep is badly affected. Children may feel sad, show oppositional or defiant behavior, and data from self evaluations indicate that children with ADHD view their most problematic behavior as less within their control and more prevalent than children without ADHD (Kaidar, Wiener, & Tannock, 2003). As children with ADHD get older, the way the disorder impacts upon them and their families changes. Symptoms are experienced in different contexts as development progresses, potentially influencing if, the level of, and domain in which impairment is experienced.

The disorder is relatively stable through early adolescence, with some individuals having a worsened course with development of antisocial behaviors, and in most individuals with ADHD, symptoms of motoric hyperactivity become less obvious in adolescence and adulthood while difficulties with restlessness, inattention, poor planning,

and impulsivity persist (*DSM-5*; American Psychiatric Association, 2013). A distorted sense of self and a disruption of the normal development of self has been reported by adolescents with ADHD (Krueger & Kendall, 2001; Harpin, 2005). Additionally, excessively aggressive and antisocial behavior may develop, adding further problems (Harpin, 2005). Research also indicates that young people with ADHD are at increased risk of academic failure, dropping out of school or college, teenage pregnancy, and criminal behavior (Harpin, 2005). For example, most teens that have experienced issues resulting from their ADHD symptoms continue to display significant impairments in their emotional, behavioral, and social functioning (Barkley, 2006b). Consequently, ADHD symptom presentation between childhood and adulthood influences outcome in adulthood, and ADHD continues to impact individuals as they transition into and during adulthood.

Attention-Deficit/Hyperactivity Disorder in Adulthood

As many as 60% of those experiencing ADHD symptoms during childhood continue to have symptoms, impairment, or both in adulthood (Weiss, Hechtman, & Weiss, 2001; Weiss, Hechtman, Milroy, & Perlman, 1985). Interpersonal problems with employers and colleagues as well as other employment problems are caused by lateness, absenteeism, excessive errors, and an inability to accomplish expected workloads (Harpin, 2005). Relationship difficulties and break-ups are more common for adults with ADHD, and risk of drug and substance abuse is significantly increased in adults with persisting ADHD symptoms who have not been receiving medication (Biederman,

Wilens, Mick, Faraone, & Spencer, 1998; Harpin, 2005). Additionally, comorbid disorders may impact on individuals with ADHD throughout their lives, and it is estimated that at least 65% of children with ADHD have one or more comorbid conditions (Biederman, Newcorn, & Sprich, 1991). Consequently comorbid disorders or developmental effects of ADHD alone may impact what and how symptoms of ADHD present in adulthood versus pre-adulthood. Although many adults with ADHD have never been diagnosed, which may impact the findings of the current body of literature addressing adult ADHD and suggest that only more severe cases of the disorder diagnosed in childhood and persisting into adulthood are being considered and included in analysis, the results of research on adult ADHD such as that done by Biederman et al. (2006) reports that adults with ADHD are restless and easily bored, constantly seek novelty and excitement, may experience work difficulties, impaired social relations, and suffer from depression, low self-concept, substance abuse, and personality disorder. ADHD symptoms, resulting impairment, and the relationship between them are likely to differ depending on age of diagnosis, course, access to treatment, resilience, and cognitive coping abilities.

Issues with Adult ADHD Diagnosis

Although ADHD is a lifelong condition for many, adult ADHD is currently underdiagnosed and undertreated. Consequently ADHD symptoms are causing adults to suffer greater impairment personally, professionally, socially, and financially. The inadequacy of current diagnostic practices for adult ADHD is a complex problem related

to issues with how adult ADHD is viewed by both mental health professionals and individuals as well as screening tools. Gender differences in child and adult ADHD is an important issue with multiple possible explanations and requires further study. Another criticism is that self-report of symptoms rather than informant accounts is an integral component of adult ADHD assessment, however this is susceptible to recall bias. Additionally, there are potential issues with the underreporting or over reporting of symptoms. There are also potential issues with client age influencing how adult ADHD symptoms are interpreted by clinicians. Because adults with ADHD often exhibit symptoms such as low self-esteem, low mood, and irritability, these symptoms may sometimes be confused with dysthymia, cyclothymia or bipolar disorder, and with borderline personality disorder (Kooij et al., 2010). Another criticism of assessing or screening for ADHD in emerging adult and adult samples is that inattention type ADHD symptoms may remain unrecognized for individuals with sufficient coping strategies and resources until the individual experiences the demands of employment or the demands of attending college.

If individuals who, during childhood and adolescence may or may not meet diagnostic symptom criteria, but possess characteristics such as superior coping strategies, an adequate level of executive functioning, or develop in environments with supportive external structures, support from parents, or experience more support in classroom settings during childhood because of smaller class size, which may reasonably function to prevent the individual from experiencing impairment, then it is reasonable to think that in some cases, adults seeking an ADHD assessment are experiencing

impairment for the first time or on a more meaningful level, and that the transition into adulthood or onto a college campus is elevating the severity of the individuals ADHD symptoms as performance demands increase and support and structure decrease. Indeed research asking if adult onset ADHD is a distinct entity examined the assumed continuity of ADHD in a representative birth cohort of 1,037 individuals followed to age 38.

Castellanos (2015) reported that 61 participants (6%) were identified as meeting *DSM-III* criteria for ADHD in childhood, and 31 participants (3.1%) met *DSM-5* criteria for ADHD at age 38 based on self-reports and informant reports. Surprisingly the two groups of individuals barely overlapped and only three participants exhibited the expected continuity from childhood into adulthood (Castellanos, 2015). Second and most important is the finding of the emergence of a substantial group of individuals who met all *DSM-5* criteria for ADHD except that of onset by age 12 (Castellanos, 2015). “The inescapable conclusion is that a substantial number of individuals in a representative community sample exhibit impairing symptoms that are consistent with ADHD in all aspects except childhood onset,” (Castellanos, 2015). In general, the severity of ADHD influences if symptoms of ADHD may decrease to levels of non-significance for some individuals, and if individuals develop coping strategies effective enough to allow normative functioning. Better outcomes are more likely for those whose symptoms are less severe and who receive good care, supervision, and support from their parents and teachers, and who have access to economic and community resources, including educational, health, and mental health services (Kessler et al., 2005b). Together, ADHD

severity as well as the amount and type of resources available to an individual, impact adult ADHD and its effect on the individual at multiple levels.

Adult ADHD remains vastly under recognized and undertreated, with only 10-25% of adults with the disorder diagnosed and adequately treated (Castle, Aubert, Verbrugge, Khalid, & Epstein, 2007). The need for and utility of a validated screening tool for adult ADHD is illustrated by research surveying primary care practitioners (PCP's). Results of a study surveying 400 PCP's indicated that PCP's are more comfortable with other disorders than with adult ADHD, are twice as likely to refer individuals with adult ADHD than to refer those with suspected bipolar disorder, and reported that 85% of respondents felt that a validated screening tool to assist in the diagnosis of adult ADHD is needed (Adler, Shaw, Sitt, Maya, & Morrill, 2009). To begin to construct such a screening tool, it is first important to understand the relationship between and functions of symptoms, impairment, and executive functioning, as they relate to adult ADHD.

Symptoms vs. Symptom Severity vs. Impairment

Conceptually, it is important to distinguish between terms used in research and assessment tools. Barkley et al. (2006c) provide a useful summation explaining the difference between symptoms of ADHD (the behavioral expressions associated with this disorder – they are the actions demonstrated by those having the disorder that are believed to reflect that disorder such as inattention, distractibility, impulsive responding, hyperactivity, etc.), and impairments (the consequences that ensue for the individual as a

result of behaviors). In general, symptom severity is determined by the frequency of symptom behaviors. In current assessment tools such as the ASRS v1.1 (see Appendix A pgs. 69 - 72) that is accomplished using a Likert scale with response options ranging from “never” to “very often.” This distinction is not always made clear; the terms are often confused or overlap and the DSM illustrates this point. For example one symptom, avoiding tasks that require sustained mental effort, could be the consequence of another symptom such as being distractible (Barkley et al., 2006c).

Increasingly ADHD has come to be understood as a disorder of impaired executive functioning and motivational deficits that manifest differently at various points throughout development, and contemporary definitions of Executive Functions (EFs) focus on EF as self-regulation (Barkley, 2014). However currently the symptoms of ADHD in the *DSM-5* are still based on those originally established for children and adolescents ages 4-17, contributing to limitations for assessing the symptoms of ADHD in adults as symptoms of EF’s are underrepresented (Barkley, 2014).

Examining items related to Executive Function and Functional Impairment with items currently included in many of the screening and diagnostic tests related to ADHD would be valuable for assessing adult ADHD. Barkley (2014) explains that regulation (i.e. intact EF) provides individuals with the ability to define, organize, and enact plans across time, often in concert with others and using social means, to achievement delayed though personally desirable benefits whose reward is delayed and perhaps even entails a short-term cost. The inability or impairment of these abilities is symptomatic of adult ADHD. Executive functions have been demonstrated to be a reliable diagnostic indicator

of adult ADHD (Kessler et al., 2010), and the EF model provides clinicians with a framework with which to listen and conceptualize the presenting complaints of adults seeking an evaluation for ADHD (Barkley, 2014).

Currently, there is no single screening instrument, inventory, or test that both considers functional impairment, and reliably and accurately identifies or diagnoses the symptoms and impairments associated with adult ADHD. In the *DSM-5* establishing impairment is a required element of the diagnosis of ADHD, and although a clear link among symptoms of ADHD, executive dysfunction, and presenting problems can often be drawn in the course of an assessment, a direct and causal link between symptoms and impairments often seems easy to establish however the two constructs are not identical and are only partially correlated (Barkley, 2014). Consequently, this means that while current screens, tests, and even diagnostic criteria for ADHD claim to assess and consider impairment, their conceptualization and operationalization of impairment is inappropriately constructed on the basis of symptom severity and executive dysfunction, and vulnerable to validity issues stemming from problems with self-reporting.

Symptom Assessment

Regarding approaches to measuring ADHD symptoms, several rating scales are useful for adults specifically. Assessment of adults using the Adult ADHD Self-Report, and the Conners Adult ADHD Rating Scales require both childhood and current symptoms. The Barkley Adult ADHD Rating Scale – IV has established reliability and validity and was empirically derived using an adult population. The BAARS includes a

self-report quick screen and a battery of scales developed to assess current symptoms; it also assesses impairment in different domains. Additionally, the Adult ADHD Self-Report Symptom Scale version 1.1 (ASRS v1.1) is a useful screening tool for identifying individuals at risk for adult ADHD that assesses symptom count and symptom severity, although it is not intended to provide a diagnosis.

The Adult ADHD Self-Report Scale (ASRS) v1.1 is an 18-item scale developed by the World Health Organization (WHO) work group in conjunction with the creation of the WHO World Mental Health (WMH) Survey Initiative version of the WHO Composite International Diagnostic Interview (WMH-CIDI) as a means for providing a valid self assessment of ADHD symptoms (Kessler et al., 2005a). The eighteen questions included in the ASRS v1.1 are consistent with the ADHD criteria put forth by the DSM-IV and addresses ADHD symptoms in adults. The symptom presentation of the ASRS v1.1 Symptom Checklist uses adult-specific language in a self-rated, frequency based format with symptoms rated on a 0–4 scale (0 “never,” 1 “rarely,” 2 “sometimes,” 3 “often,” and 4 “very often”); (Adler et al., 2009). A positive score indicates the need for a thorough clinical evaluation with a healthcare professional.

Executive Function Inventories

Five semidistinct EF domains include (1) time management, (2) organization and problem solving, (3) self-control, (4) self-motivation, and (5) emotional management. Although these domains contribute to a single large factor such as self regulation or future-directed behavior, EF inventories are useful to clinicians as they help identify and

target an individual's symptoms and impairment, and in turn inform treatment strategies (Barkley, 2014).

Examples of EF inventories include the Barkley Deficits in Executive Functioning Scale (BDEFS; Barkley, 2011a), and the Behavior Rating Inventory of Executive Function-Adult Version (BRIEF - A; Roth & Gioia, 2005). Summarizing Barkley (2014), using both self and observer report forms, the Barkley Deficits in Executive Functioning Scale (BDEFS) is a more recent EF inventory that provides a norm-based measure of executive dysfunction. The five EF domains that constitute the five subscales of the BDEFS are Self-Regulation to Time, Self-Organization/Problem Solving, Self-Motivation, Self-Restraint, and Self-Regulation of Emotions. Severity of symptoms is rated on a 4-point scale ranging from those that are/were *never or rarely* a problem (1, or minimal) to those that are/were *very often* a problem (4, or severe). Both of these measures require both observer and self report measures.

The Executive Function Index (EFI) is a self-rating measure of executive function containing five subscales developed through a factor analysis of items of other self-rating executive function measures and an item analysis (see Appendix A pgs. 73 – 76). It correlates well with objective measures of executive functioning and is quick and easy to administer (Spinella, 2005). There are 27 items total, and the five scales include Motivational Drive, Organization, Strategic Planning, Impulse Control, and Empathy. Items are rated on a 5-point Likert-type scale (1 = Not at all, 3 = Somewhat, 5 = Very much). Items of the empathy scale reflect a concern and well being of others, prosocial behaviors, and a cooperative attitude (Spinella, 2005). Strategic Planning items address

tendencies to think ahead, plan, and use strategies (Spinella, 2005). Organization items address the ability to carry organized goal-directed behavior through functions like multitasking, sequencing, and holding information in mind in order to make decisions (Spinella, 2005). Motivational Drive items address behavioral drive, activity level, and interest in novelty, and Impulse Control items address self-inhibition, risk taking, and social conduct (Spinella, 2005). Subscale scores and a total score can be calculated.

The EFI has several advantages over other executive function measures. It can be easily adapted to be administered online, and it incorporates a wide array of executive functions, all of which are not covered in other self-rating measure (Spinella, 2005). It is a short but comprehensive measure developed in a community rather than clinical sample, and can be easily administered to large samples (Spinella, 2005). For these reasons the EFI appears to be a reasonable measure to use for this project.

Functional Impairment

Considering that impairment is a required element for ADHD diagnosis and, that current ADHD symptom checklists, adult ADHD inventories, and EF inventories do not assess for impairment directly, functional impairment inventories should be utilized when assessing for ADHD. Summarizing Barkley (2014), the Adult ADHD Quality-of-Life Scale (AAQOL; Broad, Johnston, Able, & Swindle, 2006), Barkley Functional Impairment Scale (BFIS; Barkley 2011b), and the Weiss Functional Impairment Rating Scale – Self Report (WFIRS-S; Weiss, 2000) provide individuals with a way to quantify and identify specific domains of impairment (see Appendix A pgs. 59 – 69). The

AAQOL is a brief, self-report inventory of relative satisfaction with different domains of life and adult role functioning in which items are rated on a 5-point scale that ranges from *not at all/never* to *extremely/very often*. Subscale scores for Life Productivity, Life Outlook, Relationships, Psychological Health, as well as a Total Score are also available. A norm-based measure allowing for an individual's score to be compared with age and gender based norms, the BFIS measures functioning and is not limited to ADHD. For either self- or other-reporting, respondents rate items on a 10-point scale of severity of functional difficulties in each of 15 domains of major life events. A Total score as well as a score for each domain can be calculated and used to identify where an individual is impaired. Both self- and observer-report forms are available for the WFIRS-S, in which items are rated on a 4-point scale that ranges from *never or not at all* to *very often or very much*. WFIRS-S subscales include Family, Work, School, Life Skills, Self-Concept, Social, Risk, and Total.

There are multiple approaches to measuring functional impairment in adults with ADHD. Multidimensional rating scales assess multiple domains of impairment. Domain-specific scales assess a single domain of impairment, but narrowband scales are specific for ADHD-related impairment and are relatively brief, whereas broadband scales assess impairments across a range of psychopathologies (Epstein & Weiss, 2012).

Given that our goal is to assess for impairment related to adult ADHD symptoms in multiple domains, the Weiss Functional Impairment Rating Scale – Self Report (WFIRS-S; 2000) is an attractive option. As described in research evaluating the psychometric properties of the WFIRS-S and its utility in research, assessment, and

treatment of ADHD in emerging adults, “the WFIRS-S focuses on seven domains that are clinically relevant to ADHD in adulthood, including (a) family relations (eight items), (b) work adjustment (11 items), (c) school performance (11 items), (d) life skills (12 items), (e) self-concept (five items), (f) social functioning (nine items), and (g) risk-taking (14 items)” (Canu, Hartung, Stevens, & Lefler, 2016). The WFIRS-S also provides a total score. The WFIRS-S is an ADHD specific measurement of impairment for adults.

Responses on the Likert scale range from never or not at all to very often or very much. Here it is important to note that the WFIRS-S assesses impairment frequency. The WFIRS-S has excellent internal consistency, intercorrelations between domains, validation by factor analyses, test-retest validity, sensitivity to change, and receiver operating characteristics to determine cutoff scores and normative data (Epstein & Weiss, 2012).

The WFIRS-S frames questions to assess not only symptoms, but also to what degree an individual’s behavior or emotional problems have impacted various clinically-relevant domains of functioning (Weiss, 2000). To calculate the overall mean rating of impairment (range of 0 to 3) all item response values are summed and then divided by the total number of items that have been endorsed (Weiss, 2000). Any item scored a 2 or 3 is two standard deviations outside the clinical norms for ADHD and would be considered impaired (Weiss, 2000). A threshold for determining impairment in any domain is either two items scored 2 or one item scored 3 (Weiss, 2000). Weiss (2000) reports that the WFIRS has internal consistency of greater than .9 with excellent sensitivity to change, and

a higher correlation between symptom change and improvement in ADHD symptoms than any previous measure.

While other measures of impairment in adults exist, they are less appropriate for our research. The Barkley Functional Impairment Rating Scale is a norm-based measure allowing for an individual's score to be compared with age and gender based norms, however its measures are not limited to ADHD. Likewise, the Adult ADHD Quality of Life Scale is a brief, self-report inventory of relative satisfaction with different domains of life and adult role functioning in which items are rated on a 5-point scale. AAQOL subscale scores are provided for Life Productivity, Life Outlook, Relationships, and Psychological Health are offered as well as a Total Score. Because we are interested in a college population the WFIRS-S is more appropriate for our study as it provides domain scores (such as school) that are more relevant to our focus than those measured by the AAQOL or BFIS and it is ADHD specific.

Hypotheses

It was expected that participants who screen positive for ADHD would show higher impairment than participants who do not screen positive for ADHD. Similarly, it was expected that participants with lower executive functioning scores would show higher impairment than participants with high executive functioning scores. In addition, correlational analyses were expected to show a) a positive correlation between ADHD symptomology and the overall level of impairment, and b) a negative correlation between overall executive functioning and overall impairment.

The primary two hypotheses of this project were more specific:

Hypothesis 1) Individuals who screen positive for ADHD on the ASRS v1.1 and high in executive functioning on the EFI would show less impairment than individuals who screen positive for ADHD but low in executive functioning.

Hypothesis 2) Individuals who screen negative for ADHD on the ASRS v1.1 and high in executive functioning would show less impairment than individuals who screen negative for ADHD but low in executive functioning.

CHAPTER II

METHOD

Participants

Participants were recruited through the Psychology Research Pool (PRP) at Mississippi State University. The PRP consists of students who participate in research to earn required participation points or extra credit for undergraduate Psychology classes.

Data collection occurred during the spring semester of 2017. The initial sample consisted of 888 participants. Age was the only exclusionary criteria, and 20 questionnaires were discarded as a result. The reported age of participants included in the final analyses ranged from 18 to 25 years old. This age range was selected to ensure maximum generalizability to other traditional college-aged populations. Forty-four indicated that they had not responded truthfully and were discarded. Finally, three were discarded because they did not respond to two or more items included in a measure. The final sample consisted on 821 participants. A power analysis was performed to identify the number of participants needed for analyses related to the two primary hypotheses. This power analysis indicated that at least 350 participants were needed. Testing for a large effect size while assuming a 20% invalid response rate, adjusting for expected rate of positive ASRS v1.1 screens and rates of high executive functioning, a power analysis

was conducted and yielded a target sample size of $350 + 20\% = 420$ to recruit. The final sample size of 821 participants was expected to allow for adequately powered analyses.

The questionnaire contained validity items to check for attenuation and truthfulness. These included items that asked participants to report if they had been truthful, and to select “agree” from five choices. Participants were asked to identify the color of an orange from four choices, and were prompted to slide a bar to the midpoint of a scale. Responses of participants who miss two of these three validity questions were excluded. Responses of participants who skipped two validity questions, and participants who skipped one and missed one were excluded. Responses of students who report that they have not answered truthfully were also discarded.

Materials

Participants completed the questionnaire on-line, answering up to 129 questions that were delivered using the Qualtrics platform (Qualtrics, 2015). Each participant received the same questionnaire. Demographic questions asked about the following: ADHD diagnosis, age, gender, ethnicity, and current living arrangement.

The construct of ADHD related symptoms was measured using responses to the items included in the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a). This measure was developed for the World Health Organization (WHO) and has been found to have high levels of specificity and sensitivity (Kessler, 2005a). The ASRS v1.1 has good test-retest reliability (Matza, Van Brunt, Cates, & Murray, 2010), and has

demonstrated high internal consistency and convergent validity (Adler et al., 2006; Adler et al., 2012).

To measure the construct of executive functioning, participants completed the Executive Function Index (Spinnella, 2005). The EFI consists of 27 items and is a self-report measure for adults. It yields an overall score for executive functioning five scales include Motivational Drive, Organization, Strategic Planning, Impulse Control, and Empathy. The EFI has good intrascale reliability (Spinella, 2005). Strong correlations with other self-rating executive functions scales have demonstrated the convergent validity of the measure (Spinella, 2005).

To measure the construct of functional impairment, participants completed the Weiss Functional Impairment Rating Scale – Self Report (WFIRS-S) (Weiss, 2000). The WFIRS-S yields domain scores for family relations, work adjustment, school performance, life skills, self-concept, social functioning, risk-taking and a total score. The WFIRS-S has robust interval reliability, cross-informant agreement on par or superior to other measures of ADHD symptomatology and impairment, and concurrent validity (Canu et al., 2016).

Procedure

Participants located the study via the undergraduate Psychology Research Program website and filled out the questionnaire, which was administered via Qualtrics, after having completed an informed consent procedure. Individuals were then awarded research credit after participating in the study.

Design

This study utilized between-group analyses to address the stated hypotheses. For the analysis, individuals endorsing four or more significant symptoms, as defined by the scoring guidelines provided for the measure, were defined as positive screens on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a). Individuals endorsing three or fewer symptoms at significant levels were defined as negative screens. A median split was used to define high and low executive function. In our analyses, total scores on the Executive Function Index (Spinnella, 2005) from 0-117 were defined as low executive function. Any scores above 117 (up to 156 – the highest observed score) were defined as high executive function. The total score on the Weiss Functional Impairment Rating Scale – Self Report (WFIRS-S) (Weiss, 2000) was used in analyses to indicate severity of impairment.

CHAPTER III

RESULTS

In addition to reviewing the characteristics of the sample used in this research, this section discusses the general relationships found between the 3 target variables (ADHD symptoms, executive functioning, impairment), and describes the analyses conducted for the hypotheses proposed. Analysis conducted for Hypothesis 1 assessed impairment differences among participants who screen positive for ADHD, comparing impairment of individuals high in executive functioning and individuals low in executive functioning. Analysis conducted for Hypothesis 2 assessed impairment differences among participants who screen negative for ADHD, comparing impairment between individuals high in executive functioning and individuals low in executive functioning. Statistical analyses were conducted using IBM SPSS Version 24.0 (IBM, 2016).

Demographics and Descriptive Statistics

The final sample consisted of 821 participants. Of this sample, 226 (27.5%) identified as male, 593 (72.2%) identified as female, and 1 (0.1%) identified as other. The majority of this sample (64.9%) identified as Caucasian ($n = 533$). In the remainder of the sample 231 (28.1%) identified as African American, 26 (3.2%) identified as Other, 16 (1.9%) as Hispanic, 13 (1.6%) as Asian, and 2 (0.2%) as Pacific Islander. The mean age was 19.65, with a standard deviation of 1.42. The majority of the sample (47.3%)

identified as freshmen ($n = 388$) while 166 (20.2%) identified as sophomores, 142 (17.3%) identified as juniors, 124 (15.1%) identified as seniors, and 1 (0.1%) identified as other. Additionally, 98 (11.9%) reported a diagnosis of ADHD in their lifetime, and 722 (87.9%) reported never receiving a diagnosis of ADHD.

In the final sample, 675 (82.2%) screened negative (ADHD S-) and 146 (17.8%) screened positive (ADHD S+) on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a). Using a median split of 117 on the Executive Function Index (Spinnella, 2005), 408 (49.7%) were classified as having low executive function and 413 (50.3%) were classified as having high executive functioning. The mean impairment score on the Weiss Functional Impairment Rating Scale – Self Report (WFIRS-S) (Weiss, 2000) was 30.52, with a standard deviation of 27.78.

To test our two primary hypotheses, participants in the final sample were sorted into groups depending on whether they screened positive or negative on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a) and whether they fell above or below the median score of the Executive Function Index (Spinella, 2005). Hypothesis 1 required examination of the 146 participants (17.8% of total sample) who screened positive on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a). Next, the Executive Function Index (Spinella, 2005) scores were reviewed. Of the 146 participants included in the analysis of Hypothesis 1, 42 (28.8%) were assigned to the high executive function (high EF)/ADHD positive screeners (ADHD S+) group while 104 (71.2%) were assigned to the low EF/ADHD S+. Participants in the high EF/ADHD S+ group account for only 10.2% of the 413 participants classified as having high EF and

only 5.1% of all participants (42/821). The 104 participants in the low EF/ADHD S+ group account for 25.5% of the 408 low EF participants, and 12.7% of all participants (104/821).

Hypothesis 2 required analyses based on the 675 participants (82.2% of total sample) who screened negative on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a). Of the 675 participants included in the analysis of Hypothesis 2, 371 (55.0%) were high EF/ADHD S-, and 304 (45.0%) were low EF/ADHD S-. The high EF/ADHD S- constituted 89.8% of the 413 high EF participants and 45.2% of all participants (371/821). The 304 low EF/ADHD S- group comprised 74.5% of the 408 low EF participants, and 37.0% of all 821 participants.

Review of General Relationships in Data Set

A one-way ANOVA supported the prediction that participants who screen positive for ADHD on the Adult ADHD Self-Report Scale (ASRS) v1.1 (Kessler et al., 2005a) would show higher impairment than participants who do not screen positive for ADHD. The two groups differed in total impairment, $F(1,819) = 123.72, p < .001$. The mean impairment score for positive screeners was 52.14 ($SD = 29.32$), and the mean impairment score for negative screeners was 25.84 ($SD = 25.12$). Levene's test for equality of variances revealed this assumption to be violated ($F(1, 819) = 8.71, p = .003$). Welch's F statistic was used and there was a significant effect of screening outcome on total impairment, $F(1, 193.60) = 101.37, p < .001$. In the sample, positive screeners reported more impairment than negative screeners. A power analysis reported power

exceeding 95.00% and confirmed that the comparison was adequately powered for a statistically significant result.

A one-way ANOVA was conducted and supported our prediction that participants with lower executive functioning scores on the Executive Function Index (Spinnella, 2005) would show higher impairment than participants with high executive functioning scores. The two groups differed in total impairment, $F(1,819) = 85.80, p < .001$. The mean impairment score for participants reporting low executive function was 39.12 ($SD = 31.91$), and the mean impairment score for participants with higher executive functioning was 22.02 ($SD = 19.59$). Levene's test for equality of variances revealed this assumption to be violated ($F(1, 819) = 63.20, p < .001$). Welch's F statistic was used and there was a significant effect of executive functioning level on total impairment, $F(1, 674.07) = 85.32, p < .001$. In the sample participants with lower executive functioning scores reported more impairment than participants with high executive functioning scores. A power analysis reported power exceeding 95.00% and confirmed that the comparison was adequately powered for a statistically significant result.

Two correlational analyses were conducted and supported our predictions that there is a positive relationship between ADHD symptoms and the overall level of impairment, and that there is a negative relationship between the strength of executive functioning and severity of overall impairment. Analyses confirmed that there is a positive relationship between ADHD symptoms and overall impairment, $r = .64, p < .001$. This analysis also confirmed a negative relationship between overall executive function and overall impairment, $r = -.36, p < .001$.

Hypothesis 1

Hypothesis 1, that “Individuals who screen positive for ADHD and high in executive function will show less impairment than individuals who score high in ADHD symptomology but low in executive function,” was not supported. A one-way ANOVA was conducted to examine differences in overall impairment between participants with high executive function who screened positive for ADHD and participants with low executive function who screened positive for ADHD. The mean impairment score for high EF/ADHD S+ was 48.00 ($SD = 26.44$), and the mean impairment score for low EF/ADHD S+ participants was 53.81 ($SD = 30.37$). The Levene’s test for equality of variances was not found to be violated ($F(1, 144) = 1.00, p = .318$), and thus, the normal ANOVA F statistic was used. There was not a significant difference in impairment among these groups, $F(1,144) = 1.18, p = .28$. Overall, high EF/ADHD S+ participants reported nonsignificantly different levels of impairment than participants with low EF/ADHD S+. A power analysis reported power exceeding 99.99% and confirmed that the comparison was adequately powered.

Hypothesis 2

Hypothesis 2, that “Individuals who score low in ADHD symptomology and high in executive functioning will show less impairment than individuals who score low in ADHD symptomology but low in executive functioning,” was supported. A one-way ANOVA was conducted to examine differences in overall impairment between participants high in executive functioning that screened negative for ADHD and

participants low in executive functioning who screened negative for ADHD. The two groups differed in total impairment, $F(1,673) = 65.43, p < .001$. The mean impairment score for participants with high EF/ADHD S- was 19.07 ($SD = 16.26$), and the mean impairment score for low EF/ADHD S- participants was 34.09 ($SD = 30.91$). Levene's test for equality of variances revealed this assumption to be violated ($F(1, 673) = 67.14, p < .001$). Welch's F statistic was used and there was a significant effect of executive functioning and screening outcome on total impairment, $F(1, 437.64) = 58.45, p < .001$. In the sample, low EF/ADHD S- participants reported more impairment than high EF/ADHD S - participants. A power analysis reported power exceeding 99.99% and confirmed that the comparison was adequately powered for a statistically significant result.

Post Hoc

Post-hoc analysis investigated the relationship between executive function and ADHD symptomology. A correlational analysis was conducted and yielded a significant negative relationship between executive function and ADHD symptomology, $r = -.29, p < .001$. Considering differential diagnostic rates and predominant ADHD types between males and females, additional analyses were conducted to investigate the effect of gender. Our two primary hypotheses were not affected by gender. Among participants screening positive for ADHD, gender and executive function were not related. However, among individuals who screened negative for ADHD, a significantly higher proportion of

women than men were categorized as having high executive function based on their responses, $\chi^2(1) = 19.66, p < .001$.

Finally, additional analyses were conducted to investigate the impact of ever having been diagnosed with ADHD, rather than using current screening status for ADHD, on our two primary hypotheses. The mean impairment score for participants who reported ever having a diagnosis of ADHD was 34.03 ($SD = 27.24$), and the mean impairment score for participants who had never been diagnosed with ADHD was 30.08 ($SD = 27.83$). An ANOVA comparing these impairment scores was not significant ($p = .187$). Using only participants who reported having been diagnosed with ADHD in their lifetime, results of an ANOVA conducted for Hypothesis 1 were not significant ($p = .372$). Additionally when conducted using these participants, results of an ANOVA for Hypothesis 2 were also not significant, but this finding is divergent from our results for our primary analysis ($p = .098$). Results of the two ANOVAs when conducted using participants who have never been diagnosed with ADHD did not differ from results of the primary analyses.

CHAPTER IV

DISCUSSION

This study examined two primary hypotheses related to the relationship between Attention-Deficit-Hyperactivity Disorder (ADHD) symptoms, executive function, and impairment. The following discussion attempts to interpret the meaning of our results in the context of the existing literature on the topics, considers the strengths and limitations of this research, and discusses implications for future research.

Impairment, Executive Function, and ADHD Symptomology: General Relationships

Predictions about the general relationships between executive function, ADHD symptomology, and impairment were supported. Our results demonstrated that higher symptomology and lower executive function both correspond with greater impairment, and both lower symptomology and higher executive function correspond with less impairment.

Our results identified a positive relationship between ADHD symptomology and impairment, demonstrating that individuals high in ADHD symptomology experience significantly more overall impairment than individuals lower in ADHD symptomology. Previous research has demonstrated this relationship as well, however it cautions that although diagnostic processes for ADHD often assume a close relationship between symptom count and impairment, symptoms often predict less than 25% of variance in

impairment (Gordon et al., 2006). More recently, Mannuzza et al. (2011) investigated the relationship between impairment and symptoms in adult males diagnosed with ADHD in childhood. This research reported extremely strong correlations ($r = .83$ to $r = .85$) between impairment and symptom count in adults (Mannuzza et al., 2011). Barkley et al. (2006a) explains that measures of impairment that cover multiple life domains have a stronger relationship with symptoms in adults, suggesting that adults may be vulnerable to more impairment as they take on more personal responsibilities. Despite more comprehensive measures of impairment having stronger relationships with symptoms, Barkley et al. (2006a) go on to support the distinction between impairment and symptoms in research. Additional research further supports the distinction between impairment and symptoms, explaining that impairment rather than symptoms are the primary reason individuals seek services, and arguing that because impairment is moderated by a number of internal and external factors in ways ADHD symptoms are not, it is important to consider the two constructs separately (Hodgkins, Dittmann, Sorooshian, & Banaschewski, 2013). Although symptoms have been established as a useful predictor of current and future impairment, this relationship does not sufficiently explain differences in impairment among individuals high in symptomology. In order to better explain differences in impairment among individuals high in symptomology, it is necessary to expand beyond symptomology alone and understand the role of executive function and its influence on how symptomology is experienced as well as its predictive value for impairment.

Regarding the relationship between executive function and impairment, our results replicate previous research findings, indicating that there is a negative relationship between executive function and impairment, and individuals with higher executive function experience significantly less impairment than individuals low in executive function (Barkley & Murphy, 2010; Wåhlstedt, Thorell, & Bohlin, 2008). A meta-analysis examining the executive function theory of ADHD explained that although deficits in executive function are related to greater impairment, executive function is not a sufficient explanation for symptoms of ADHD, rather executive function appears to be distinct from both symptoms and impairment (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Other research has reported a relationship between executive function and impairment in adults, finding that rating measures of executive function in daily life specifically, are more predictive of impairment than other executive function measures and tests (Barkley & Murphy, 2010). The current literature distinguishes executive function from both impairment and ADHD symptoms, and indicates that executive function rating measures, such as the EFI, assess behaviors whereas executive function performance tests measure cognitive ability (Barkley & Murphy, 2010; Toplak, West, & Stanovich, 2013). It may be that behavior, rather than impairment, is more useful in predicting impairment among adults. Additionally, it may be that behaviors influence the expression of ADHD symptoms, and reduce their clinical severity. If this is the case, high executive function may contribute to the incidence of false negatives during ADHD assessments. Understanding executive function then, is critical in how adult ADHD is conceptualized and assessed.

Executive Function and Impairment Differences Among Individuals High in ADHD Symptomology

Among individuals who screened positive for ADHD, individuals with high executive functioning were less impaired than individuals with low executive functioning, however, this difference was not significant. It should be noted that of the four groups for our two primary hypotheses, mean impairment was greatest among individuals with low executive function who also screened positive for ADHD. Considering our sample consisted of individuals attending college, and that our measure of executive function assesses behavior related to achieving goals rather than ability, it may be that executive function scores were more similar than scores in the general population because our sample has higher executive function and less variance. Additionally, current literature suggests that lower executive function, as measured by the EFI, would be associated with less goal directed behavior, such as attending class, and accomplishing fewer goals such as completing research for class credit (Barkley & Murphy, 2010; Toplak, West, & Stanovich, 2013). As a result, individuals with low executive function may have been less likely to participate in this research, and the ability to detect a significant difference in our sample may have been further limited. The failure to detect significant differences in impairment between these two groups may be a result of over reporting of symptoms by individuals who may not be experiencing the level of impairment typically associated with their reported symptoms. Also because symptomology and deficits in executive function are highly correlated (Willcutt, et. al, 2005), and because deficits in executive function may contribute to higher

symptomology, individuals who screened positive for ADHD who are also high in executive function may be rare as they were in our data set. Additionally, it may be that their impairment scores are being underreported due to individuals low in executive function being underrepresented.

According to the executive function theory of attention-deficit/hyperactivity disorder, these results occurred because symptoms could result directly from a primary deficit in executive function (Willcutt, et. al, 2005). In this line of reasoning then there should not be individuals with both high executive function and high ADHD symptomology. However our data indicates that individuals may be both high in executive function and ADHD symptomology, and research suggests that despite a strong relationship between executive function and symptomology, deficits in executive function are not required for symptomology to occur, rather executive function is one of many factors that contribute to the presentation of ADHD symptoms and the severity of the related impairment (Willcutt, et. al, 2005).

It may be that high executive function serves as a protective factor, although insufficient, against impairment. Higher executive function may improve an individual's ability to cognitively and behaviorally respond to impairment directly. By improving an individual's ability to cope with impairment, executive function may reduce the severity of impairment. Executive function may indirectly reduce impairment via its relationship with ADHD symptoms. High executive function may reduce the severity of ADHD symptoms so that these symptoms are experienced, reported, and observed as being below clinical significance. Higher executive function may improve an individual's

ability to cope with the behavioral and cognitive symptoms of ADHD. Consequently, due to high executive function, these symptoms may be less impairing and may also be interpreted or reported as less severe during assessment. It is likely that high executive function reduces symptoms directly by providing individuals with a greater ability to cope with impairment, and indirectly by reducing the severity of behavioral and cognitive ADHD symptoms and decreasing their impact on an individual's functioning. Considering the positive correlation between symptoms and executive function, this may well explain both the difficulty in achieving an adequately powered sample for Hypothesis 1, and the insignificant result. Future research in this would benefit from a larger sample if using the same or similar statistical methods. Use of more sensitive or sophisticated analyses however may be better able to detect differences with a similar or smaller sample.

Executive Function and Impairment Differences Among Individuals Low in ADHD Symptomology

Among individuals who screened negative for ADHD, there was a significant difference in impairment between individuals high in executive function and individuals low in executive function. Of the four conditions examined with our two primary hypotheses, mean impairment was lowest for individuals with high executive function who screened negative for ADHD. The finding that negative screeners are generally less impaired than individuals with high symptomology is consistent with previous literature examining adults (Kooij et al., 2010). Additionally, research investigating the relationship between ADHD symptom severity and academic impairment in children suggests that symptom severity has a strong positive relationship with academic impairment,

specifically behavioral symptomology, even when controlling for executive function (Barry, Lyman, & Klinger, 2002). Research indicates that adults often experience fewer symptoms as they mature but that symptoms can result in greater impairment in more domains (Mannuzza et al., 2011), and impairment rather than symptoms is the primary motivation for seeking services (Hodgkins, Dittmann, Sorooshian, & Banaschewski, 2013). It may also be that high symptomology resulting in greater impairment elicits some coping behaviors that would be measured by the executive function measure used in this research, resulting in higher executive function scores among ADHD+ individuals and high EF individuals. Among individuals low in symptomology however, symptomology may not be severe enough to motivate coping strategies. It may be that the low EF/ADHD- group is significantly more impaired than the high EF/ADHD- group because they exhibit fewer goal oriented behaviors in general, and ADHD symptoms, while causing impairment, are not severe enough to motivate goal oriented behaviors.

Strengths and Limitations

One strength of this study is the size of the sample collected, as it allowed adequate power for the planned analyses. Several other studies have investigated the relationships between executive function, ADHD symptoms, and impairment, however this is the first known study to combine these three constructs in an effort to identify and compare individuals included in the selected four groups.

One limitation of this study is its reliance on self-report measures. Research has found that generally, individuals diagnosed with ADHD tend to underreport symptoms,

and individuals who have never been diagnosed tend to over report symptoms (Sibley et al., 2012). In the research conducted by Sibley et al. (2012) the mean age of participants was 20.20. Although our primary hypotheses relied on current ADHD symptom screens rather than historical diagnostic status, the average age of our sample is similar to that reported by Sibley et al. (2012), and our data may have been affected by underreporting and over reporting of symptoms based on prior diagnosis. Regarding Hypothesis 1, it may be that individuals over reporting symptoms were included in one of the groups. However it is unlikely that these over reporting individuals are experiencing the greater levels of impairment associated with more valid symptom reports. As a result, the mean impairment of the conditions included in Hypothesis 1 may have been affected. Specifically, it may be that mean impairment of the two conditions was deflated due to responses from these over reporters. Regarding Hypothesis Two, because ADHD diagnosed individuals may underreport symptoms, some of the negative ADHD screeners may have been miscategorized into a condition less representative of their actual experience. If this is the case, it may be that among individuals high in symptomology, there exists a significant difference in impairment depending on level of executive function. Because the measures of executive function and impairment used in this study also rely on self-reporting, they may also suffer from over reporting or underreporting. Although the measures used in this research have been demonstrated to have good validity, the potential issues cause concern over the sensitivity and specificity of ADHD assessments and screening tools. Because over reporting and underreporting may have occurred on our measures, some participants may be better represented in a condition

other than the one they were assigned. Although over reporting or underreporting may have affected our data, the Weiss Functional Impairment Rating Scale has demonstrated good cross-informant agreement (Canu, Hartung, Stevens, & Lefler, 2016), and both the Executive Function Index (EFI) and the Adult ADHD Self-Report Scale (ASRS) v1.1 have been demonstrated to be psychometrically sound (Kessler et al., 2005a; Spinella, 2005).

Another limitation of this study is the use of a college student sample. Because our sample consists of individuals between the ages of 18 and 25, results may not generalize to children, adolescents, or older adults. Considering that individuals with ADHD in our college sample may also exhibit higher functioning in general compared to adults with ADHD who have never attended college, our results may not be generalizable to other populations. A specific limitation of ADHD research is that there may be fewer people with ADHD who attend college, and those who do may be higher functioning (especially fewer hyperactive/impulsive symptoms versus younger ADHD samples; APA, 2013). Indeed research has reported that individuals with ADHD are less likely to graduate high school or attend college compared to their non-ADHD peers (Green & Rabiner, 2012; Green & Rabiner, 2013). Thus, because fewer individuals with ADHD attend college it may be that our sample is less representative. Additionally, ADHD symptoms and impairments in skills such as planning are associated with poorer performance in school. If ADHD students are less likely to succeed in school, they may be less likely to attend class and participate in class activities or complete class requirements such as research. As a result, it may be that some students experiencing a

greater number of symptoms or more severe symptoms resulting in greater impairment did not participate in research and were not included in our study. Specifically, the generalizability of findings is likely limited because the available population of ADHD students were a) successfully enrolled in higher education, and b) were functioning at a high enough level to successfully participate in an out of class research activity that required a fair amount of effort and skill to locate and complete. Thus, the ADHD levels in this kind of sample are likely skewed towards the highest functioning ADHD people in this age range. Indeed, low EF ADHD students may be underrepresented because of the skills and performance histories necessary to be enrolled and then successfully complete the study. It is impossible to know to what degree this restriction exists in this particular study. In fact, Hypothesis 1 may have not turned out significant due to a failure to gain participation from those so low in EF that they could not independently complete required tasks in the survey.

Finally, a majority of our sample consisted of female students from a single, large university setting in the Southeastern part of the United States. Although a majority of undergraduate students currently attending 4-year universities are female, students enrolled in most colleges of Arts and Sciences are even more likely to be women when compared to university populations in general. Because ADHD diagnoses rates are higher for men and because the symptoms, symptom expression, and impairment characteristic for men and women differs, our results were obtained with a less severely affected cohort than exists outside of the study.

Implications and Future Directions

Although there was not a difference in impairment among positive screeners in our sample, negative screeners were found to differ in their level of impairment. Independently, executive function and screening outcome were both predictive of impairment. Executive function and screening outcome were also related, and a better understanding of this relationship could help future research better understand the relationship of each construct with impairment.

One future direction for this research includes developing a better understanding of low executive function. Specifically, future research could investigate how low executive function relates to college enrollment and success. It is likely that participants identified as having low executive function in a college sample have, on average, higher executive function than individuals who have never attended college. As a result, future research investigating the hypotheses proposed in this study could focus on recruiting a more representative sample that includes more individuals with low executive function.

Because executive function and ADHD symptomology are both related to impairment, future research could expand current understanding of their relationships with impairment by further investigating their relationship. In order to better understand this study's results, future research could explore how executive function influences or predicts the strength of the relationship between ADHD symptomology and impairment. Research could explore how ADHD symptomology influences or predicts the strength of the relationship between executive function and impairment. This may help future research better understand and explain ADHD related impairment. Specifically ongoing

research in this area may shed light on differences in how impairment is experienced depending on an individual's executive function.

Another future direction could include collecting additional information regarding ADHD type. Future studies may explore the relationship between ADHD type and executive function, symptoms, and impairment. This would involve a much more thorough collection of data and it may prove difficult to collect a sample size large enough for analyses to be adequately powered. However, a multisite research effort conducted in collaboration with other universities may allow for the recruitment of an adequately sized sample. Collaborative research efforts in this area may also enjoy greater generalizability of results, especially if universities of different sizes and in different regions are involved.

Additional research in this area could also replicate this study using different measures of executive function. As mentioned previously, this research used a executive function rating measure that assesses behavior. Future studies may employ executive function performance tasks that assess cognitive ability rather than behavior. Research of this kind may help inform intervention strategies aiming to reduce impairment by eliciting the activation of an individual's underlying abilities.

Replication of the current study and future research has implications for how ADHD in emerging adults is conceptualized, assessed, and treated. Findings may clarify how emerging adults present with ADHD, and will better explain the relationship between executive function, symptoms, and impairment in this population specifically. This would inform improved screening and assessment strategies developed for ADHD

in emerging adults. Specifically, research in this domain may help improve the sensitivity, specificity, positive predictive value, and negative predictive value of instruments designed for use in this population. Considering what is currently known and considered during assessment and diagnosis of ADHD in adults (i.e. adults typically have less behavioral expressions and generally present with fewer symptoms overall when compared to children and adolescents), additional research into impairment and the interaction between executive function and ADHD symptoms may influence and inform the conceptualization of adult ADHD and the diagnostic criteria included in future iterations of the *DSM*.

Additionally, considering our finding that impairment did not differ between ADHD diagnosed participants and participants who have never been diagnosed with ADHD suggest that current interventions are effective. However, future research may reduce ADHD related impairment further through the integration of new information into the development of interventions that address symptoms more directly. This information may also lead to the development of interventions capable of improving executive function, and reducing ADHD related impairment as a direct result. Taken together this research may lead to the development of interventions that result in meaningful and lasting change in an individuals behaviors and cognitions rather than simply targeting the symptoms of ADHD. Generally, the current project and future research may contribute to a greater understanding of ADHD in emerging adulthood, and can reduce ADHD related impairment by informing future assessments and interventions.

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APPENDIX A

MENTAL EFFORT, ATTENTION, AND FUNCTIONING QUESTIONNAIRE

Questionnaire

Q1 What is your current age?

- 17 or younger (1)
- 18 (2)
- 19 (3)
- 20 (4)
- 21 (5)
- 22 (6)
- 23 (7)
- 24 (8)
- 25 (9)
- 26 or older (10)

Skip To: End of Survey If What is your current age? = 17 or younger

Skip To: End of Survey If What is your current age? = 26 or older

Q2 Please select your gender

- Male (1)
- Female (2)
- Other (3)

Q3 What category most closely reflects your current academic classification?

- Freshman (1)
- Sophomore (2)
- Junior (3)
- Senior (4)
- Unclassified (5)
- Other (6)

Q4 Please select your ethnicity

- Caucasian (1)
- African American (2)
- Asian (3)
- Pacific Islander (4)
- Hispanic (5)
- Other (6)

Q5 What is your current living arrangement

- Single sex resident hall (1)
- Co-ed hall (2)
- Other University housing (3)
- At home (4)
- Fraternity house (5)
- Sorority house (6)
- Off campus (7)

Q6 What is your current Greek life affiliation?

- Member (1)
- Non-member (2)
- Past member (3)

Q7 FAMILY: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Having problems with family (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Having problems with spouse/partner (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Relying on others to do things for you (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Causing fighting in the family (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Makes it hard for the family to have fun together (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems taking care of your family (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems balancing your needs against those of your | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

family (7)

Problems
losing control
with family (8)



Q8 WORK: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|--|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Problems performing required duties (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with getting your work done efficiently (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with your supervisor (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems keeping a job (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Getting fired from work (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems working in a team (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with your attendance (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with being late (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems taking on new tasks (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems working to your potential (10) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Poor
performance
evaluations
(11)



Q9 SCHOOL: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Problems taking notes (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems completing assignments (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems getting your work done efficiently (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with teachers (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with school administrators (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems meeting minimum requirements to stay in school (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| problems with attendance (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with being late (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with working to your potential (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Problems with
inconsistent
grades (10)



Q10 LIFE SKILLS: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Excessive or inappropriate use of internet, video games or TV (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems keeping an acceptable appearance (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems getting ready to leave the house (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems getting to bed (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with nutrition (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with sex (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems with sleeping (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Getting hurt or injured (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Avoiding exercise (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems keeping regular appointments with | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| doctor/dentist (10) | | | | | |
| Problems keeping up with household chores (11) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems managing money (12) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Q11 SELF CONCEPT: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|----------------------------|------------------------------|-----------------------|-----------------------------------|-----------------------|
| Feeling bad about yourself (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Feeling frustrated with yourself (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Feeling discouraged (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Not feeling happy with your life (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Feeling incompetent (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Q12 SOCIAL: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Getting into arguments (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Trouble cooperating (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Trouble getting along with people (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems having fun with other people (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems participating in hobbies (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems making friends (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Problems keeping friends (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Saying inappropriate things (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Complaints from neighbors (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Q13 RISK: Please mark the rating that best describes how often your emotional or behavioral problems have affected each item in the last month.

| | Never or not at all (1) | Sometimes or somewhat (2) | Often or much (3) | Very often or very much (4) | n/a (5) |
|---|-------------------------|---------------------------|-----------------------|-----------------------------|-----------------------|
| Aggressive driving (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Doing other things while driving (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Road rage (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Breaking or damaging things (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Doing things that are illegal (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Being involved with the police (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Smoking cigarettes (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Smoking marijuana (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Drinking alcohol (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Taking "street" drugs (10) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Sex without protection (birth control, condom) (11) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Sexually inappropriate | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | |
|----------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| behavior (12) | | | | | |
| Being physically aggressive (13) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Being verbally aggressive (14) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Q14 Please select "agree." This item is included as an attention check for responders.

- Strongly disagree (1)
- Disagree (2)
- Neither agree nor disagree (4)
- Agree (6)
- Strongly agree (7)

Q15 How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q16 How often do you have difficulty getting things in order when you have to do a task that requires organization?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q17 How often do you have problems remembering appointments or obligations?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q18 When you have a task that requires a lot of thought, how often do you avoid or delay getting started?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q19 How often do you fidget or squirm with your hands or feet when you have to sit down for a long time?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q20 How often do you feel overly active and compelled to do things, like you were driven by a motor?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Very Often (5)

Q21 Rate how well each of the following statements describes you.

| | Not at all (1) | Between not at all and somewhat (2) | Somewhat (3) | Between somewhat and very much (4) | Very much (5) |
|---|-----------------------|-------------------------------------|-----------------------|------------------------------------|-----------------------|
| I have a lot of enthusiasm to do things (1) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| When doing several things in a row, I mix up the sequence (2) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I try to plan for the future (3) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I can sit and do nothing for hours (4) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I take risks, sometimes for fun (5) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have trouble when doing two things at once, multi-tasking (6) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I'm interested in doing new things (7) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I have a lot of concern for the well being of other people (8) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I'm an organized person (9) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I save money on a regular | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

| | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| basis (10) | | | | | |
| I do or say things that others find embarrassing (11) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| People who are foolish enough to be taken advantage of deserve it (12) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I only have to make a mistake once in order to learn from it (13) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I tend to be an energetic person (14) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I make inappropriate sexual advances or flirtatious comments (15) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| When someone is in trouble, I feel the need to help them (16) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I sometimes lose track of what I'm doing (17) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| I feel protective towards a friend who is | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

being treated
badly (18)

I think about
the
consequences
of an action
before i do it
(19)

I lose my
temper when I
get upset (20)

I take other
people's
feelings into
account when
I do someting
(21)

I have trouble
summing up
information in
order to make
a decision with
it (22)

I start things,
but then lose
interest and
do something
else (23)

I swear/use
obscenities
(24)

I don't like it if
my actions or
words hurt
someone else
(25)

I use strategies
to remember
things (26)

I monitor
myself so that

| | | | | |
|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

I can catch any mistakes (27)

Q22 Please slide the bar to 50. This item is included as an attention check for responders.

0 10 20 30 40 50 60 70 80 90 100



Q23 Have you ever been diagnosed with attention-deficit/hyperactivity disorder (ADHD)?

- Yes (1)
- No (2)

Q24 Have you ever consumed a prescription stimulant medication (i.e., Vyvanse, Adderall, Concerta, Ritalin, etc.)?

- Yes (1)
- No (2)

Q25 Have you ever been prescribed a stimulant medication (i.e., Vyvanse, Adderall, Concerta, Ritalin, etc.)?

- Yes (1)
- No (2)

Q26 What color is an orange? This item is included as an attention check for responders.

- Pink (1)
- Orange (2)
- Blue (3)
- Black (4)
- Red (5)

Q27 Have you ever consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not)?

- Yes (1)
- No (2)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q28 How many times have you consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not) during your LIFETIME?

- None (1)
- 1-2 times (2)
- 3-5 times (3)
- 6-9 times (4)
- 10-19 times (5)
- 20-39 times (6)
- 40 or more times (7)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q29 When did you first consume someone else's prescription stimulant medication (whether you had a prescription of your own or not)?

- In college (1)
- In high school (9th to 12th grade) (2)
- In grades 7th to 8th (3)
- Before 7th grade (4)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q30 Have you consumed someone else's prescription stimulant medication (whether you had a prescription or not) in the past year?

- Yes (1)
- No (2)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q31 Have you consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not) during college?

- Yes (1)
- No (2)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q32 How frequently have you consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not) in the past year?

- None (1)
- 1-2 times (2)
- 3-5 times (3)
- 6-9 times (4)
- 10-19 times (5)
- 20-39 times (6)
- 40 or more times (7)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q33 Have you consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not) in the past month?

- Yes (1)
- No (2)

Display This Question:

If Have you ever consumed someone else's prescription stimulant medication (whether you had a prescr... = Yes

Q34 Have frequently have you consumed someone else's prescription stimulant medication (whether you had a prescription of your own or not) in the past month?

- None (1)
- 1-2 times (2)
- 3-5 times (3)
- 6-9 times (4)
- 10-19 times (5)
- 20-39 times (6)
- 40 or more times (7)

Q35 Were you truthful with the responses you provided?

Yes (1)

No (3)

APPENDIX B
IRB APPROVAL

NOTICE OF APPROVAL FOR HUMAN RESEARCH

DATE: December 05, 2017
TO: Morgan Dorr, B.A., Psychology
FROM: Kari Reeves, Assoc Dean/Assoc Prof, MSU Expedited
PROTOCOL TITLE: Impairment in Adult ADHD
FUNDING SOURCE: NONE
PROTOCOL NUMBER: IRB-16-608
APPROVAL PERIOD: Approval Date: December 05, 2017

The Institutional Review Board (IRB) for the protection of human subjects has reviewed the protocol entitled: Impairment in Adult ADHD. The project has been approved for the procedures and subjects described in the protocol. This protocol must be reviewed for renewal on a yearly basis for as long as the research remains active. Should the protocol not be renewed before expiration, all activities must cease until the protocol has been re-reviewed.

If approval did not accompany a proposal when it was submitted to a sponsor, it is the PI's responsibility to provide the sponsor with the approval notice.

This approval is issued under Mississippi State University's Federal Wide Assurance 00000647 with the Office for Human Research Protections (OHRP). If you have any questions regarding your obligations under Committee's Assurance, please do not hesitate to contact us.

Please direct any questions about the IRB's actions on this project to:
Kari Reeves

Approval Period: December 05, 2017 through December 15, 2017
Review Type: EXPEDITED
IRB Number: IORG0000467

