The Relationship of General and ADHD Specific Predictors of Substance Use and College Adjustment and Functioning among ADHD College Students

by

Kirk Dillon Mochrie

July 2019

Director of Dissertation: Tony Cellucci, Ph.D., ABPP

Major Department: Psychology

Background: Recent research has demonstrated that ADHD college students are at a higher risk for substance use, academic problems, and psychosocial difficulties compared to non-ADHD students. Less is known about the role of ADHD specific factors on substance use and psychosocial/academic adjustment as well as the possible interaction of substance use and ADHD factors on college adjustment.

Purpose: The current research sought to understand predictors of substance use and possible relations between ADHD factors, substance use, and psychosocial/academic adjustment among ADHD college students.

Methods: Sixty-six ADHD undergraduates were asked to complete a series of online self-report inventories related to ADHD, substance use, and college adjustment. Participants also completed a semi-structured interview for current ADHD diagnosis, an objective behavioral assessment of ADHD impairment, and answered qualitative questions about ADHD college student functioning.

Results: General factors (i.e., substance use history, history of conduct problems, positive expectancies, and peer influence) were good predictors of current substance use and consequences. ADHD specific factors (i.e., severity of ADHD symptoms,

impulsivity, emotion dysregulation, and executive functioning deficits) were not predictive of substance use, although several ADHD specific factors significantly predicted substance use consequences. Participants with higher emotion dysregulation as well as executive functioning deficits struggled with more psychosocial/academic difficulties. Higher severity of ADHD symptoms predicted more current symptoms of depression/anxiety and more academic adjustment difficulties. Of note, substance use was not a good predictor of psychosocial/academic outcomes in this sample. However, interactions of alcohol and particularly marijuana with various ADHD specific factors significantly predicted GPA.

Discussion: ADHD College students with higher scores on general substance use predictors were more likely to engage in more frequent and heavy substance use with increased negative consequences. Although the ADHD factors did not predict substance use, ADHD students with greater symptoms, higher impulsivity, higher emotion dysregulation, and higher executive functioning deficits were more likely to experience substance-related problems. Overall, severity of ADHD specific factors most increased an individual's risk for college adjustment difficulties. Targeted prevention and intervention strategies for incoming students with ADHD should be aimed at increasing awareness and coping skills for ADHD as well as incorporate psychoeducation about substance abuse risk.

The Relationship of General and ADHD Specific Predictors of Substance Use and College Adjustment and Functioning among ADHD College Students

A Dissertation

Presented to the Faculty of the Department of Psychology

East Carolina University

In Partial Fulfillment of the Requirements for the Degree

Doctor of Philosophy in Health Psychology

By

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APPROVED BY:

DIRECTOR OF Dissertation:

Tony Cellucci, Ph.D., ABPP

COMMITTEE MEMBER:

Matthew Whited, Ph.D.

COMMITTEE MEMBER:

Robert Carels, Ph.D.

COMMITTEE MEMBER:

Christy Walcott, Ph.D.

COMMITTEE MEMBER:

Robert Morphet, M.A.

CHAIR OF THE DEPARTMENT OF PSYCHOLOGY:

Erik Everhart, Ph.D.

DEAN OF THE GRADUATE SCHOOL:

Paul J. Gemperline, Ph.D.

DEDICATION

This dissertation is dedicated to my grandfather, Dr. Richard Douglas Mochrie, for his consistent love and encouragement throughout my life as well as his devoted investment in my education. As a professor at North Carolina State University for most of his academic career, he instilled in me a passion for lifelong learning and academic pursuits. In addition, we shared in an experience that few others have; the arduous task of obtaining a doctorate degree. Sadly, he passed away during my doctoral studies and the writing of this dissertation. However, I will never forget the countless conversations we engaged in, particularly about research and academics that played a major role in my enthusiasm for higher education. It was obvious he was very proud when shaking my hand after I obtained a Masters degree; I know he would be even more thrilled to know that I have completed this project and am graduating with a doctorate degree. Richard, you were very loved and are now greatly missed; I am honored to have called you grandfather.

ACKNOWLEDGEMENTS

I would like to acknowledge my mentor, Dr. Tony Cellucci, and express my gratitude for his support, encouragement and guidance, not only on this dissertation project, but in all of my academic accomplishments.

I would also like to thank the other members of my committee, Dr. Matthew Whited, Dr. Robert Carels, Dr. Christy Walcott, and Robert Morphet for their suggestions, advice and support during the course of this research project.

Finally, I would like to thank the undergraduate research assistants Alexandria Morrison, Aieshwarya Singh, and Rebecca Harrell for all their hard work on this project.

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CHAPTER I: INTRODUCTION

ADHD is considered a neurodevelopmental disorder characterized by a variety of symptoms of inattention and/or hyperactivity that must begin before age 12 (American Psychiatric Association, 2013). There are a number of associated impairments among emerging adults and college students with ADHD including attendance problems, poor academic performance, lower GPAs, limited educational attainment, and poor occupational performance, (DuPaul, Morgan, Farkas, Hillemeier, & Maczuga, 2016; Kessler, Adler, Barkley, Biederman, Conners, Demler, & Spencer, 2006). In addition, there are various comorbid psychiatric conditions associated with ADHD among college students, including substance use, depression, and anxiety (Yang, Tai, Yang & Gau, 2013).

The link between ADHD and substance use among college students has been well established (Mesman, 2015; Rooney, Chronis-Tuscano, & Yoon, 2012). Research demonstrates that college students with ADHD are at a greater risk for using substances earlier, developing substance disorders, experiencing negative consequences from substance use, and having more resultant difficulty with academic achievement than those without ADHD (Baker, Prevatt, & Proctor, 2012; Hartung, et al., 2013; Mesman, 2015; Rooney et al., 2012). There is less research pertaining to the predictors of substance use involvement among ADHD college students. The increased risk or link between ADHD and substance use is often understandably conceptualized as due to possible ADHD specific predictors of substance use. These include severity of ADHD symptoms, impulsivity, emotion dysregulation, and executive functioning deficits (Blanchard, Stevens, Littlefield, Talley, & Brown, 2017; Blume & Marlatt, 2009; Glass & Flory, 2011).

However, additionally, there is substantial evidence that many college students in general engage in substance use and often experience negative consequences from this use. For example, alcohol, marijuana, other illicit drugs, and misuse of non-prescribed stimulant medication among college students have all been associated with poorer academic functioning and difficulties in psychosocial functioning (Egan, Reboussin, Blocker, Wolfson & Sutfin, 2013; Knee & Neighbors, 2002; Wechsler, Lee, Kuo, Seibring, Nelson & Lee, 2002). Moreover, there is a considerably larger literature on predictors of substance abuse and associated negative consequences among college students in general that can be seen as overlapping with ADHD substance use risk. These common or general predictors of substance use among college students include history of conduct disorder, past alcohol and other drug use history, peer influence on alcohol and other drug use, alcohol and other drug use expectancies, and personality characteristics such as sensation seeking. All of these factors have research to support their link to substance use and associated consequences, regardless of ADHD status among college students (Cyders, Flory, Rainer, & Smith, 2009; McGue, Iacono, Legrand, Malone, Elkins, 2001; Reifman & Watson, 2003; Skidmore, Kaufman, & Crowell, 2016; Wahesh, Lewis, Wyrick, & Ackerman, 2015). This raises the question of the relative importance of and the relationship between general versus specific ADHD risk factors in determining substance use involvement among college students with ADHD.

It has been established that ADHD students are an at-risk group as their ADHD status is associated with possible negative impacts on psychosocial and academic functioning compared to non-ADHD college student peers (Blasé, Gilbert, Anastopoulos, Costello, Hoyle, Swartzwelder, & Rabiner, 2009; Dan & Raz, 2015; Frazier, Youngstrom, Glutting, & Watkins, 2007; Weyandt & DuPaul, 2013a; Yang et al., 2013). However, college student substance abuse itself has been linked to similar negative psychosocial and academic outcomes (Egan et al., 2013; Homman, Edwards, Cho, Dick, & Kendler, 2017; Knee & Neighbors, 2002; O'Conner, 2016; Wechsler et al., 2002). This raises a second related question as to the possible role increased use of alcohol and other drugs plays in the difficulties experienced by ADHD diagnosed college students (Mochrie, Whited, Corson, Freeman, Cellucci, Lothes, 2016).

The available study findings in the literature pertaining to ADHD and substance abuse among young adults are not without limitations. The majority of current studies that assess ADHD and substance use among college students have employed between-group designs. This method does not account for differences within ADHD samples that may predict substance use and associated consequences. Further, most studies have not confirmed diagnoses or used objective behavioral tasks to aid in the assessment of ADHD symptoms and instead only employ self-report assessment. Moreover, alcohol and marijuana use in this population has been well researched; however, misuse of stimulant medication among ADHD college students and its effects on psychosocial/academic adjustment is rarely included in the same studies and remains unclear (Molina & Pelham, 2014). In addition, there are few studies that examine multiple predictors of substance use among ADHD students in a single model, with no studies to date that attempt to separate out general and ADHD specific predictors of substance use among an ADHD sample. Finally, there has not been an examination of the role that substance use might play as a moderator of ADHD symptom severity and psychosocial and academic functioning outcomes. Molina and Pelham (2014) call for future studies to measure ADHD symptom severity, history of CD as a mediator/moderator of SUD risk in ADHD populations, and ADHD-related impairments in the context of substance use. Further, they highlight the importance of examining constructs from the substance abuse literature such as alcohol expectancies, as they have received little attention to date, and also to assess multiple risk factors within a single model. The presented study addressed some of these issues emphasized by Molina and Pelham (2014).

Specifically, the presented study addressed several identified gaps in the literature by evaluating the relationship of general and ADHD specific predictors to substance use and any associated negative outcomes in a sample of ADHD college students. Psychosocial and academic adjustment functioning were examined as well. In addition, the study methodology included a greater effort to verify past diagnosis of ADHD and included both objective behavioral assessment of ADHD symptom impairment in a laboratory session as well as the more frequently employed self-report measures. Finally, the presented study assessed the role of substance use as a possible moderator of the known difficulties in academic adjustment and psychosocial functioning commonly experienced among ADHD students.

CHAPTER II: LITERATURE REVIEW

Attention-Deficit Hyperactivity Disorder

ADHD Definition, Diagnosis, and Assessment. Research on Attention-Deficit Hyperactivity Disorder (ADHD) has grown rapidly due to the increasing number of diagnosed individuals identified with ADHD since the establishment of the diagnosis in 1987 (Matte et al., 2015). ADHD is considered a neurodevelopmental disorder characterized by symptoms of attention and self-regulation difficulties that begin in childhood. There are several primary symptoms of ADHD that emerge during childhood and include both inattentive and hyperactive problems. The *Diagnostic and Statistical Manual for Mental Disorders, fifth edition* defines the disorder as a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development (American Psychiatric Association, 2013).

Children must meet six or more criteria that persist for at least six months with five or more criteria for older adolescents and adults being diagnosed. Inattentive symptom criteria include: Issues with attention to detail, difficulty sustaining attention, not able to listen, difficulty following through on instructions, difficulty organizing tasks or activities, avoiding tasks requiring sustained mental effort, losing items necessary for tasks, becoming easily distracted, and experiencing forgetfulness in daily activities (APA, 2013). Further, an individual may exhibit hyperactive symptoms of ADHD which include: Fidgeting with hands or feet or squirming in seat, leaving seat inappropriately, running about or climbing excessively (may be limited to feeling restless in adolescents and adults), difficulty engaging in leisure activities quietly, being “on the go” or “driven by a motor”, talking excessively, blurting out answers before questions are completed, having difficulty waiting for a turn at an activity, and interrupting or intruding on others (APA, 2013). These symptoms must have an onset in childhood (now defined as before age 12), demonstrate cross-setting occurrence, and result in impairment in major life activities. In addition, the symptoms must clearly interfere with social, occupational, or academic functioning. Clinicians who diagnose ADHD specify if the individual has predominantly an inattentive presentation, a hyperactive/impulsive presentation or a combined presentation (APA, 2013).

The use of the DSM criteria and childhood assessment methods to diagnose ADHD in childhood has been accepted practice in the United States. However, diagnosis of ADHD among adults is more recent, with a relative lack of evidence-based methods for identifying ADHD in adulthood (Barkley, 2015; Matte et al., 2015; Sibley et al., 2012). Previous versions of the DSM made it difficult to diagnose adults with ADHD. For example, studies have identified an “aging out” effect of ADHD as children move into adulthood (Sibley et al., 2012). The research has shown that some adults no longer meet DSM criteria for ADHD but still exhibit persistent core symptoms and serious dysfunction. Moreover, adults with ADHD tend to underreport their symptoms, further complicating the diagnostic picture. Utilizing the DSM in diagnosing adults with ADHD is also problematic due to some of the diagnostic questions being aimed towards children, rather than adults, especially in previous versions. Sibley and colleagues suggest that informant reporting is more important than using the DSM in diagnosing adult ADHD (Sibley et al., 2012). Similarly, Haavik and colleagues argue that adult assessment of ADHD should emphasize clinically significant impairments, a clinical interview, symptom rating scales (past and present), collateral information from multiple informants if possible, and assessment of other psychiatric symptoms and disorders (Haavik, Halmøy, Lundervold, & Fasmer, 2010).

With the arrival of DSM-5 in 2013 there were several changes that resulted in a somewhat different diagnostic definition of ADHD (Matte et al., 2015). Barkley (2015) outlines these changes in detail, including one of the most significant changes, the shift in age requirement of initial symptoms being present from 7 to 12 years. Specifically, individuals are now required to have "several inattentive or hyperactive-impulsive symptoms present prior to age 12". Other significant changes included: adding examples to the criterion items that apply across the lifespan (not just to children); the cross-situational requirement now must include several symptoms in each setting; subtypes have been replaced with "presentation specifiers", which map onto the subtypes (i.e., inattentive, hyperactive/impulsive, and combined types); comorbid autism spectrum disorder is now allowed to be diagnosed, and a symptom threshold change from 6 to 5 for diagnosis of ADHD among adults (Barkely, 2015). Finally, the disorder was placed in the neurodevelopmental disorders section of the DSM-5.

There have been several concerns expressed regarding these changes including increase in prevalence rates of the disorder, and possible over diagnosis and associated over treatment. Interestingly, Matte et al. (2015), assessed 4,000 young adults 18-19-year-olds without ADHD (N = 3,858; males = 49.1%; Caucasian = 64.1%) and with ADHD (N = 142; males = 39.4%; Caucasian = 59.3%) from the 1993 Pelotas Birth Cohort Study to assess ADHD findings using the DSM-5 ADHD diagnostic criteria. A major finding was a 27% increase in the prevalence rate of ADHD with DSM-5 compared to using DSM-IV TR criteria. More positively, the findings showed that the new criteria are more conducive to diagnosing adults with ADHD. In addition, the findings reinforced the idea that a lower cut off threshold for number of inattentive and hyperactivity/impulsivity symptoms is appropriate for diagnosing ADHD among young adult populations, as was implemented in the DSM-5.

Current ADHD diagnosis among young adults often utilizes self-report assessment measures to gather information on specific symptoms and impairment in an individual's life (Green & Rabiner, 2012). Self-report inventories are a necessary but not sufficient aspect of ADHD diagnostic assessment. It is less common; however, highly recommended that adults being assessed for an ADHD diagnosis be given a more comprehensive evaluation (Sibley et al., 2012). Recommended assessment of ADHD should include informant reports from multiple contexts. Among college students or adults who are working these can be collected from parents, professors, colleagues, and supervisors. Further, other comorbid disorders, such as depression and/or anxiety should be considered and ruled out as a source of inattentiveness through evaluation in this population (Barkley, 2015). Thus, assessment of ADHD in adults should include developmental history and comprehensive measurement and should attempt to steer away from an overreliance on self-report measures, especially among emerging adults and college students (Green & Rabiner, 2012).

The majority of current studies examining ADHD and substance use among college students have not provided a comprehensive diagnostic evaluation. Many do not obtain parent verification of diagnosis or use diagnostic interviewing. Most do not use objective behavioral tasks to aid in the diagnosis of ADHD. In addition, most studies employ between-subjects' designs, comparing groups of individuals with and without ADHD on a variety of variables. Future research should incorporate objective behavioral measures into their assessment of ADHD among adults. In addition, studies should examine current ADHD symptoms as well as diagnosis relative to substance use.

ADHD Prevalence and Etiology. Prevalence rates taken from past population surveys indicate that five percent of children and two and a half percent of adults meet diagnostic criteria for ADHD in the world (APA, 2013). These prevalence rates have been increasing with overall population estimates of ADHD closer to eight percent (Thomas, Sanders, Doust, Beller, & Glasziou, 2015). In the US, prevalence rates are higher among Caucasian males compared to ethnic minorities and females. For example, studies have shown that among children the ratio of prevalence rates between males and females is 2:1, with a ratio of 1.6:1 among adults (APA, 2013).

Although the exact etiology of ADHD is unclear, it is thought there is a heavy genetic component (Fliers, Vasquez, Poelmans, Rommelse, Altink, Buschgens, ... & Miranda, 2012). Heritability studies find that individuals with a first-degree biological relative with ADHD are at a greater risk of developing the disorder than those that do not have relatives with ADHD (APA, 2013). Some researchers have suggested pathway models of ADHD which propose the disorder is a behavioral expression of dysfunction in several brain systems, primarily in the frontal lobe (Van Hulst, de Zeeuw & Durston, 2015). Other studies have used functional magnetic resonance imaging (FMRI) to assess brain areas involved in the etiology of ADHD. For example, Vasic and colleagues used FMRI to examine 14 adults with ADHD against a control group of 12 healthy matched adults, to assess brain functioning during a cognitive task (Vasic, Plichta, Wolf, Fallgatter, Sosic-Vasic & Grön, 2014). Findings showed that hypoactivation of the left inferior frontal cortex was related to ADHD and might represent a neurofunctional marker of processing errors in adults with ADHD.

Moreover, literature suggests there are both categorical and dimensional differences between normal developing individuals and those with ADHD. For example, Van hulst and colleagues examined outpatient clinic patients previously diagnosed with ADHD (N = 96; *M* age = 12.9) versus a control group (N = 121; *M* age = 13.9) to identify separate sub-groups among ADHD individuals with deficits in cognitive control, timing, and reward sensitivity (Van hulst, de Zeeuw, & Durston, 2015). Results suggested subgroups of ADHD due to different brain areas showing specific dysfunction including ADHD individuals with poor cognitive control and those with poor temporal processing.

Currently, there are numerous studies demonstrating the role of neurophysiology in the etiology of ADHD. However, clinically, there is no single accepted marker for ADHD beyond developmental history and symptom criteria. As indicated above, some research would suggest that individuals now diagnosed with ADHD are likely to be heterogenous in their neurophysiological and behavioral difficulties.

Development and Course of ADHD. Based on genetic studies of ADHD development, it is likely that many individuals are born with a genetic predisposition or an increased risk for the development of ADHD. Symptoms of ADHD often begin to manifest in early childhood and are usually observed by the child's caregivers, teachers, family friends, etc. Some research indicates that sometimes individuals with an ADHD diagnosis in childhood are able to cope more effectively as adults, experiencing less symptoms, and do not require the same level of treatment as when they were children

(Cheung, Rijdijk, McLoughlin, Faraone, Asherson & Kuntsi, 2015). However, there are mixed findings on the prevalence of pervasive ADHD symptoms stemming from childhood persisting into adulthood. Some research indicates that lower childhood Intelligence (IQ) and Socioeconomic (SES) status are significant predictors of increased ADHD symptoms and impairment among adults (Cheung et al., 2015). Future research needs to examine factors associated with differences in symptom severity and other impairments in greater detail among young adults with ADHD.

The majority of young adults with a childhood diagnosis continue to experience elevated ADHD symptoms and clinically significant impairment as adults (Sibley, Pelham, Molina, Gnagy, Waxmonsky, Waschbusch & Kuriyan, 2012). There is a particular risk for impairment from ADHD among adolescents and college students (Cheung et al., 2015). It is well known that individuals do not suddenly develop ADHD as adults; however, those who were diagnosed as children and continue to struggle with ADHD as young adults constitute a unique population. However, as these individuals typically vary in severity of symptoms and associated impairments/consequences, research needs to unravel the influencing factors accounting for these differences.

ADHD symptoms often cause difficulties in social, behavioral, school functioning and social rejection among children (APA, 2013). Among adults, associated impairments can include limited educational or job attainment, attendance problems, poor occupational performance, and higher probability of unemployment, and interpersonal conflict (Kessler, Adler, Barkley, Biederman, Conners, Demler, & Spencer, 2006). Many emerging adults struggle with obtaining higher levels of educational attainment, possibly due to a lack of coping and executive functioning skills needed to achieve success at this academic level. Further, emerging adults primarily struggle with decreased success at work, job loss, and further educational attainment (Kuriyan et al., 2013). As previously discussed, the diagnosis of ADHD is typically made in childhood; however, some individuals do not seek treatment for various reasons until they reach the young adult age, resulting in assessment and diagnostic challenges. More research needs to assess ADHD college students to identify predictors of functioning and impairment to better understand differences in this population.

ADHD Comorbidities. There are many challenges in assessment of ADHD. One such challenge is a high rate of comorbid psychiatric disorders associated with ADHD both in childhood and adulthood (APA, 2013). Individuals often experience other learning disorders in addition to ADHD. Further, individuals with ADHD often suffer from mental health disorders such as substance use, depression, and anxiety. Specifically, Yang, Tai, Yang & Gau, (2013), found that childhood diagnosis of ADHD and co-occurring anxiety and depression predicted decreased quality of life in young adults. They suggest that individuals may struggle with anxiety and/or depression with comorbid ADHD and these serve as mediators that should be assessed to help inform treatment (Yang et al., 2013). Further, Lan and colleagues studied emerging adults with comorbid ADHD and bipolar disorder, assessing suicide attempts (Lan et al., 2015). Individuals who had comorbid ADHD and bipolar disorder had an increased likelihood of attempted suicide compared with those with just bipolar disorder. It seems the impulsivity associated with ADHD may play a role in behavioral issues associated with other disorders, such as suicide attempts among those with comorbid bipolar disorder.

Many individuals with ADHD also have difficulties with self-esteem and test anxiety. Dan and Raz (2015) reported that young adult females with ADHD exhibited significantly higher levels of test anxiety and lower levels of self-esteem compared to a control group. Unfortunately, individuals who struggle with ADHD are likely to have problems with testing, regardless of any comorbidity. These results indicate that these individuals may struggle even more with testing due to the comorbidity of test anxiety and ADHD as well as lower self-esteem levels.

Also, conduct disorder (CD) and substance use are highly prevalent comorbid disorders among individuals with ADHD (APA, 2013). Specifically, Willcutt and colleagues found that one fourth of children and adolescents with ADHD (combined inattention and hyperactivity) also meet criteria for CD (Willcutt, Nigg, Pennington, Solanto, Rohde, Tannock, & Lahey, 2012). Adults with ADHD may have higher rates of latter antisocial and other personality disorders compared to those without ADHD (APA, 2013).

Finally, in addition to comorbid emotional and conduct difficulties, individuals with ADHD are at an increased risk for developing substance use disorders as adolescents and adults. This will be outlined in more detail in later sections.

College Students with ADHD and their Needs. Most individuals with ADHD obtain less schooling, have poorer vocational achievement, and have reduced intellectual scores than their peers (APA, 2013). However, more students with a past diagnosis of ADHD are now attending college (Weyandt & DuPaul, 2013a). Research has demonstrated that high school academic achievement significantly predicts enrollment in college among individuals with ADHD (Kuriyan et al., 2013). It is likely these individuals have less severe symptoms and may have developed effective coping mechanisms compared to their peers with ADHD that do not attend college. In addition, these individuals may use a variety of compensatory strategies and have high cognitive ability allowing them to obtain post high school education (DuPaul, Morgan, Farkas, Hillemeier, & Maczuga, 2016). Unfortunately, this does not mean that college students with ADHD do not experience unique and even significant problems in functioning. Individuals with ADHD that are able to begin college are still considered a unique population that may experience increased difficulties in adjustment compared to non-ADHD college peers.

Academic concerns have been well document when comparing ADHD to non-ADHD college students. College students with ADHD are known generally to have increased difficulties in college, including academic concerns and lower GPAs as well as psychosocial and emotional concerns, including depression (Blasé, Gilbert, Anastopoulos, Costello, Hoyle, Swartzwelder, & Rabiner, 2009; Green & Rabiner, 2012). Various studies that use group comparisons of ADHD students versus controls find lower overall GPAs among ADHD college students (Blase et al., 2009; Frazier et al., 2007; Weyandt & DuPaul, 2013a). Moreover, there is research highlighting negative outcomes among college students with ADHD including poor performance on class assignments, higher rates of academic probation, higher rates of dropping classes, and lower rates of graduation (Frazier et al., 2007; Turnock, Rosen, & Kaminski, 1998; Weyandt et al., 2013a; Wolf, 2001). Finally, specific studies have demonstrated that college students with ADHD report significantly more general academic problems compared to non-ADHD peers (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999).

In addition, emotional functioning is of concern in the college ADHD population. For example, Blasé and colleagues (2009) found that ADHD students scored half a standard deviation higher on the CES-D measure of depression than non-ADHD students among a sample of 3,379 college undergraduates (Female = 66%, Caucasian = 66%) (Blasé et al., 2009). Bray (2014) also reported that individuals with ADHD endorsed experiencing a greater number of past depressive episodes during college, as well as current depressive symptoms, when compared to college students without ADHD in a sample of college student juniors and seniors. Some research even demonstrates a link between ADHD and lower quality of life among college students compared to those without ADHD (Yang et al., 2013). Moreover, a recent study of 1,748 college undergraduates (*M* age = 18.51; Female = 68.4%; Caucasian = 71.3%; Freshman = 80.1%), revealed a link between depression scores on the PHQ-9 and ADHD, with ADHD students reporting higher scores than non-ADHD peers (Mochrie, Whited, Corson, Freeman, Cellucci, & Lothes, 2016).

ADHD is also potentially an important risk factor for adjustment to college including substance use (Blasé et al., 2009). These problems may be particularly evident in the early college years when students are still adjusting to the increased demands of college and exposed to increased opportunities to use alcohol and other drugs. The specifics of the association between ADHD and substance use among college students will be discussed in detail in later sections.

Intervention efforts targeted at emerging adults and college students with ADHD are necessary and currently underutilized, although research in this area is beginning to develop (Green & Rabiner, 2012). Anastopoulos and King (2015) developed and piloted a program called Accessing Campus Connections and Empowering Student Success (ACCESS) utilized with 43 ADHD college undergraduates ages 17-27 (*M* age = 20.3), predominately female (62.8%) and Caucasian. This encompassed a Cognitive Behavior Therapy (CBT) group and individual ADHD coaching during a maintenance phase of treatment. Results showed increases in ADHD knowledge, use of organizational skills, and reductions in maladaptive thinking. In addition, there were reductions in ADHD symptoms, improvements in executive functioning, educational benefits, improved emotional well-being, and increased use of disability services and other campus resources among all participants; providing preliminary evidence for the use of CBT with ADHD. Several other studies have demonstrated similar findings, suggesting that CBT is an effective intervention for college students with ADHD (Young, Moghaddam, & Tickle, 2016).

However, to date, such programs have not specifically targeted substance abuse risk. Recently, Franklin and colleagues reported that their program did not impact substance use and that future efforts should be directed at this outcome (Franklin, Jaffe, Fletcher, DuPaul, Anastopoulos, Weyandt, 2017). Further, emerging adults (18-25 years) are twice as likely as adolescents and older adults to be diagnosed with a SUD, and account for more than 20% of SUD treatment seekers (Bergman, Kelly, Nargiso, & McKowen, 2016). Data currently suggests that these individuals can also benefit from

CBT interventions, which may serve a dual role of reducing symptoms of ADHD and comorbid Substance Use Disorders (SUDs).

Future research should be aimed at assessing specific difficulties that college students with ADHD are experiencing in terms of academic and psychosocial functioning, including substance use problems. Such research might identify targets that put some ADHD college students at greater risk for adverse outcomes and thus better inform intervention development. Although there are studies (e.g., Blase et al., 2009; Dan & Raz, 2015; Egan et al., 2013; O'Conner, 2016) that assess the risk and extent of substance use among ADHD college students along with ADHD college student academic and psychosocial functioning; few have examined predictors of substance use or interaction effects among variables, nor taken into consideration how substance use influences psychosocial outcomes. The available literature on ADHD and substance use specifically with emerging adults and college students will be reviewed below, but first the paper will discuss the topic of substance use and associated problems more generally.

Substance Use and Associated Consequences

Development and Course of Substance Use. For most individuals' substance use begins in early adolescence when they begin to experiment with alcohol and other drugs. In that sense, substance use problems, like ADHD, might be considered a developmental disorder. Research indicates adolescents are more likely than adults to use alcohol as well as other drugs; especially, marijuana (Winters, 2003). Adolescents begin using alcohol or marijuana due to social reasons such as high school parties and peer influence. Most do not progress on to use "harder drugs" such as cocaine, hallucinogens, or opioids. However, for some, substance use begins with cigarettes and/or alcohol, moves to marijuana and leads to using other illicit substances, a progression which has been well documented (Kandel, 1975). For some, genetic factors may play a role in increased risk. For example, individuals who have parents who have an alcohol problem are four times more likely to develop an alcohol problem themselves and will typically begin using at earlier ages than their peers (National Institute on Alcohol Abuse and Alcoholism; NIAAA, 2017). Although many adolescents likely meet criteria for a substance use disorder at one point, they do not go on to engage in substance use behavior over the course of their lifetime (Winters, 2003). In fact, some research indicates that 22% of college students who engaged in binge drinking during their adolescence reduced their alcohol consumption before college, without intervention (Vik, Cellucci, & Ivers, 2003). Unfortunately, this is not the norm.

The majority of emerging adults, who enter college, have a trend towards increased drinking during early college years (Skidmore, Kaufman, & Crowell, 2016). College is a period of higher risk for individuals who might be vulnerable to the development of substance use difficulties due to the normative culture of experimentation with substance use. In addition, many college students consume high levels of alcohol and engage in binge drinking, adding to their risk for substance use problems beyond that of same-age peers that are not in college (Slutske, 2005). Moreover, some adolescents who begin engaging in substance use at early ages, possibly due to peer influence, may develop substance disorders and various substance-related negative consequences through college and even adulthood.

Most individuals begin to use substances less as they move from young adulthood (latter college) to middle adulthood. There are a number of factors that potentially account for this change. First, there are various social factors that contribute to this change. Peer norms against drug use likely account for some of this change in substance use beyond college years (Johnston, O'Malley, Bachman, & Schulenberg, 2011). It is likely that excessive alcohol and drug use is not as socially acceptable as individuals' age and thus there is a decrease in their overall use. Further, beliefs about drug use begin to change as individuals move from college to middle adulthood, with most individuals having less tolerant attitudes toward use (Johnston et al., 2011). Other research highlights the importance of adulthood roles, experience, and previous use in substance use patterns through college and even middle adulthood (Merline, O'Malley, Schulenberg, Bachman, & Johnston, 2004). The "maturing out hypothesis" supports this view in that many individuals who engage in frequent and higher quantities of substance use during college and early adulthood decrease their use when they take on more major role obligations such as work and parenthood.

However, the extent of past use and attitudes toward substance use remain predictors of who might have continuing difficulties. Individuals who begin using alcohol and other drugs at earlier ages may have more difficulty making these normative changes and may develop alcohol or drug use disorders as emerging adults that persistent into adulthood. It is clear that substance use changes as individuals' age due to a number of factors. It is likely these factors influence if an individual develops a substance use problem and substance-related negative consequences through college and adulthood.

There is substantial literature on the development and course of substance use patterns from adolescence to early and latter adulthood. Moreover, college student substance use patterns and associated consequences have been studied in detail. This dissertation will now briefly review what is known about college student substance use patterns and predictors and then turn to particularly focus on studies of college students with ADHD within this population.

Alcohol and Other Drug Use among College Students. It is likely that the majority of college students will experiment with alcohol use during their early college years; it is estimated that approximately 79% of all college students drink alcohol (Skidmore, Kaufman, & Crowell, 2016). What is more concerning is the number of students who engage in heavy or binge drinking which is associated with various negative consequences. Heavy alcohol consumption and/or binge drinking by college students is a major problem in the United States (Wechsler, Lee, Kuo, Seibring, Nelson & Lee, 2002). Binge drinking is typically defined as 5 or more alcoholic drinks for males or 4 or more alcoholic drinks for females on the same occasion (NIAAA, 2016). At least 35% of college students report engaging in binge drinking in the last year (Skidmore et al., 2016), with many studies showing even higher numbers. In addition, there is substantial evidence that demonstrates college students drink more alcohol and engage in binge drinking more often than their same-age peers who are not in college (Slutske, 2005). It is likely that college students are a unique sample of alcohol users, in that it may be more peer normative to engage in heavy alcohol consumption.

Heavy drinking among college students is associated with a number of negative consequences (Knee & Neighbors, 2002; Wechsler et al., 2002). In particular, heavy alcohol consumption among college students has been connected to an increased prevalence of such negative outcomes as academic difficulties, negative social-interpersonal consequences, impaired control, increased engagement in risky behaviors, and most severely, physiological dependence (Read, Kahler, Strong & Colder, 2006). These outcomes are of particular concern given that approximately half of college students in the United States report binge drinking (i.e., 5 standard drinks or more; single occasion) which directly results in an increased risk of injuries, sexual assault, and death due to alcohol poisoning (NIAAA, 2016; Wechsler et al., 2002).

Research indicates the importance of the social environment in college drinking in that the majority of alcohol consumption and pressure to drink among college students occur during social situations (Knee & Neighbors, 2002). However, studies have examined multiple factors that can influence college student alcohol use, including genetic susceptibility and history of alcohol use (i.e., high school use), which can influence current use (White & Hingson, 2014). Campus norms related to drinking can also influence alcohol use among college students. For example, if the college is located near several bars and many students frequent these establishments, the norm is to engage in more alcohol use than campuses that have limited access to alcohol. Finally, alcohol expectations, consequences for underage drinking, parental attitudes about drinking, and fraternity or sorority involvement have all been shown to influence college student alcohol use (White & Hingson, 2014). This research makes it overwhelmingly clear that some students are at a higher risk for problematic alcohol use and associated consequences than others based on these factors and others.

Moreover, marijuana use is higher among college populations compared to other individuals and age groups. Marijuana use, like alcohol, is more socially accepted during college years; which leads many students to engage in its use. Studies have found a range of prevalence of marijuana use among college students, with most results falling around 25% on average, with some ranging up to 54% of students who report using marijuana (Bell, Wechsler, & Johnston, 1997). College students may use marijuana for many reasons; however, most of them similarly report social and peer influence to be the most likely reason they engage in marijuana use. In addition, some research demonstrates that many individuals use both alcohol and marijuana simultaneously, and some students report using marijuana to cope with stress (O'Hara, Armeli, & Tennen, 2016). Undoubtedly, marijuana, similar to alcohol is commonly used among this population.

In addition, college students who engage in frequent marijuana use also may experience various negative consequences. Results of a national survey of 17,592 students at 140 college universities found that marijuana use was correlated with spending more time at parties and less time studying (Bell, Wechsler, & Johnston, 1997). In addition, marijuana use was correlated with other risky behavior including binge drinking, cigarette smoking, and having multiple sex partners. Further, some research demonstrates negative effects of marijuana use on attention and executive functioning, especially among heavy users compared to light users in college settings (Pope, & Yurgelun-Todd, 1996). This may result in lower academic achievement, lower GPAs, and poor study strategies and skills in this population. These findings have carried over into more recent studies. For example, Arria and colleagues found that after controlling for demographic and other factors, marijuana use adversely affected college academic outcomes such as poor class attendance, GPA, and graduation rates (Arria, Caldeira, Bugbee, Vincent, & O’Grady, 2015).

Interestingly, Skidmore and colleagues, in their review of college student substance use, reported that approximately 26% of male and 19.2% of female full-time college students report current illicit drug use (Skidmore et al., 2016). These numbers may seem high; however, as in many other studies, the majority of this use is accounted for by marijuana users. There is less research assessing other illicit drug use among college students which occurs at a lower rate. However, studies show that some college students are using other illicit substances. According to data from the Monitoring the Future study; in 2014, 5.4% of college students reported using LSD or other hallucinogens, 5% MDMA, 4.8% narcotics, and 3.5% sedatives in the past year (Johnston, O’Malley, Bachman, & Schulenberg, 2015). In addition, Skidmore and colleagues found that 19.6% of college students had used prescription drugs (i.e., stimulants, analgesics, or both) non-medically in their lifetime, with 15.6% reporting use within the past year (Skidmore et al., 2016). Prescription stimulant misuse is frequently observed among college students and has become another major concern within the college population.

Misuse of Prescription Stimulant Medication among College Students. There is a growing literature assessing misuse of non-prescription stimulant medications (e.g., Adderall) among the college population. A recent study found that 10.6% of college students reported using a stimulant medication not prescribed to them in the past year (Egan et. al., 2013), and other estimates put such misuse between 13% (Zullig & Divin, 2012) and 17% (Benson, Flory, Humphreys, & Lee, 2015).

College students report that their primary motives for using non-prescription stimulants are to aid in studying and concentration and to increase academic test performance (Gallucci, Martin, Usdan, 2015). Many college students even perceive the use of non-prescription stimulants for enhancement of their academic performance as culturally normative, with actual prevalence rates of use much lower than students often perceive them to be (McCabe, 2008). It is likely many college students view the use of non-prescribed stimulant medication as normative, and use stimulants to help them study, rather than obtaining a high. This issue is directly related to college students with ADHD as they are the main source of the diversion of nonprescribed stimulant medication. In addition, research demonstrates a link between stimulant abuse and misuse of alcohol and other drugs among college students (Messina, Silvestri, Diulio, Murphy, Garza, & Correia, 2014).

Messina and colleagues found that college students with a higher frequency of alcohol use and alcohol-related negative consequences also had increased odds of abusing non-prescription stimulants, with such use being associated with lower GPA and increased use of other substances (Messina et al., 2014). Moreover, simultaneous users of alcohol and non-prescription stimulants have a higher risk of experiencing negative consequences in college (Egan et al., 2013). These data run counter to student expectations of increased academic performance due to stimulant misuse. Thus, when assessing college student substance use it is important to examine alcohol and other drug use as well as to include nonprescribed stimulant medication use separately. Moreover, college students with ADHD are also misusing stimulant medication (Upadhyaya, Rose, Wang, O'Rourke, Sullivan, Deas, & Brady, 2005) due to a variety of reasons including not taking medication as directed, taking excess amounts, using other stimulants to help with studying, and combining stimulants with alcohol. This issue along with developmental use of prescribed stimulant medication and risk for substance use is described in the next section.

ADHD as a Developmental Risk Factor for Substance Use

Over the last few years, research in support of the finding that individuals with a diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) have a greater risk for developing substance use problems has increased (Mesman, 2015; Molina & Pelham, 2014). Developmental studies of ADHD children have found that they initiate smoking and alcohol use at earlier ages and are more likely to abuse alcohol and other drugs as adolescents. Moreover, some literature finds that childhood ADHD symptoms follow a path to early initiation of tobacco use through internalizing problems as well as the combination of this and peer rejection (Vitulano, Fite, Hopko, Lochman, Wells, & Asif, 2014). ADHD symptoms in childhood are also associated with a trend to earlier onset of marijuana use in adolescence. Further, it has been shown that individuals who have been diagnosed as children with ADHD are at a higher risk for adolescent substance use and developing problems with substance use later on in life (Molina & Pelham, 2014).

A meta-analysis by Lee and colleagues reiterates these findings (Lee, Humphreys, Flory, Liu, & Glass, 2011). There were several inclusion criteria for the meta-analysis including diagnostic ascertainment of ADHD with at least one control or non-ADHD group, prospective longitudinal design, binary lifetime substance use and abuse/dependence measures, available data to calculate proportions of children with and without ADHD with substance use, SUD, odds ratios provided, publication between 1980 and August 2009, and a non-intervention design. A total of 27 studies were included in the final analysis.

There were a number of findings demonstrating the developmental link of ADHD to substance use from the Lee et al. (2011) study. First, children with ADHD were more likely to use substances than children without ADHD. These children were also at a higher risk of developing substance use disorders involving a variety of substances including nicotine, alcohol, marijuana, and other less frequently used illicit drugs. Interestingly, the findings were less consistent with alcohol use. Lee et al. (2011), found that demographic factors such as age, race, and gender did not moderate the relationship between ADHD and substance use. It is likely there are a number of potential mediators/moderators involved in changes of substance use throughout the lifespan. What is currently known is that individuals diagnosed with ADHD in childhood are at an increased risk for higher levels of substance use and associated consequences.

Molina and Pelham (2003) examined the impact of specific ADHD symptoms and severity on substance use in 143 treatment-seeking adolescents diagnosed with ADHD, compared to 100 demographically similar adolescents. Findings indicated that those with ADHD were not more likely than controls to have tried alcohol, cigarettes, or marijuana, but they were three times more likely to have used other illicit drugs including inhalants, hallucinogens, cocaine, and/or non-prescribed stimulants. Further, those with ADHD reported significantly more alcohol-related problems. ADHD status thus increased the likelihood that normative exposure to alcohol and other drugs might lead to associated problems and greater drug involvement.

In addition, childhood ADHD is also associated with childhood Conduct Disorder (CD), with some adults displaying symptoms of both. Specifically, Willcutt and colleagues found that one fourth of children and adolescents with ADHD (combined inattention and hyperactivity) also met criteria for CD (Willcutt, Nigg, Pennington, Solanto, Rohde, Tannock, & Lahey, 2012). Moreover, CD and substance use are highly prevalent comorbid disorders among individuals with ADHD (APA, 2013). Individuals with a history of CD are at a higher risk for substance use and associated consequences in emerging adulthood. For example, early conduct problems are a risk factor for marijuana use among college students (Falls, Wish, Garnier, Caldeira, O'Grady, & Vincent, 2011). Both ADHD and CD predict substance use risk in emerging adulthood separately. However, even when controlling for CD in samples of ADHD students there is still an increased risk for some substance use and associated consequences (Glass & Flory, 2012). Taken together, these findings indicate that individuals with childhood ADHD are at a greater risk for substance use and associated consequences that might also extend into college years. This developmental risk for later substance use among ADHD individuals must also be examined in the context of prescription stimulant medication use.

The question of whether prescribing stimulant medication for ADHD children in childhood increases the risk of latter substance misuse has been extensively investigated. This was an early popular fear, although some authors suggested that early treatment might prevent adverse outcomes including substance use (Wilens, Adler, Adams, Sgambati, Rostrosen, Sawtelle, &… Fusillo, 2008). Even with some mixed results, there is a general consensus in the literature that medication use during childhood does not impact substance use outcomes in adulthood (Humphreys, Eng, & Lee, 2013). A meta-analysis conducted by Humphreys, Eng, and Lee (2013) examined the association of childhood stimulant medication treatment for ADHD and later substance outcomes. Studies were selected based on the following inclusion criteria: longitudinal design, binary measure identifying children with ADHD, binary substance use measures, data available to calculate the proportion of children with ADHD treated versus not treated with stimulant medication with substance use outcomes, and publication between 1980 and 2012. A total of 15 studies were used in the final analysis. There were a number of specific findings; however, the results suggested comparable adult substance outcomes between children who were treated with stimulant medication and those who were not. These findings indicate that using stimulant medication to treat ADHD children does not increase later substance use outcomes as adults.

There has also been a considerable amount of research investigating the efficacy of prescription stimulant medication use among ADHD individuals, albeit less with college students. For example, a meta-analysis conducted by Castells and colleagues showed the efficacy of prescription methylphenidate (Ritalin) use on symptoms among ADHD adults (Castells, Ramos-Quiroga, Rigau, Bosch, Nogueira, Vidal, & Casas, 2011). The analyses included a total of 18 randomized controlled trials that examined the efficacy of methylphenidate in adults with ADHD, which included measurements of clinical disorders, including SUD. Findings showed methylphenidate, at an average dose of 57.4 mg/day had a moderate effect on reducing symptoms of ADHD compared to placebo. Further, findings suggested reduced effectiveness of medication when an individual had a comorbid SUD, suggesting that substance use among individuals with ADHD may decrease the efficacy of prescription medication. Moreover, even among adults treated with ADHD medication, they still report work and interpersonal impairments (Safren, Sprich, Cooper-Vince, Knouse, & Lerner, 2010). Other authors point out the risks of prescribing stimulant medication to individuals with SUDs. For example, Kollins (2008) highlights the efficacy of short-acting psychostimulant medication for ADHD individuals, while recognizing that this may not be the best course of treatment for those at a higher risk of developing substance problems. However, the role misuse of stimulant medication plays among ADHD college students and the degree of impact substance use has on psychosocial/academic adjustment difficulties remains unclear at this time.

ADHD and Substance Use among College Students

In addition to developmental literature, there have been a few studies that have directly looked at the relationship of ADHD to substance use among emerging adults and college students. For example, Murphy and colleagues examined three groups of emerging adults to assess differences in substance use and psychological distress (Murphy, Barkley, & Bush, 2002). The groups included an ADHD, primarily inattentive type (N = 36; *M* age = 20.1; Male: 86.1%), ADHD, combined type (N = 60; Age: *M* = 21.3; Male: 71.7%), and a non-ADHD group (N = 64; Age: *M* = 21.1; Male: 68.8%). Findings indicated that ADHD compared to non-ADHD individuals had significantly lower IQs and educational attainment, used more illicit substances, reported more instances of being considered by others to be drinking too much, and reported more psychological distress on the SCL-90. Interestingly, there were group differences between subtypes of ADHD, with the combined type group reporting being considered by others as “dependent” on a substance and having a history of ODD.

Given that emerging adulthood is arguably the peak developmental period for problems related to substance use to occur, an extensive search of the literature was conducted for studies during this age period. Table 1 provides an overview of studies found that investigated the association between ADHD and substance use among emerging adults and college students. The table is organized by chronological dates from earlier to more recent findings. The sections in the table include the researchers and date of publication, participant information, study measures used, main findings, and a summary section which includes the study design, limitations, a short summary of the study, ADHD prescription medication use (if reported), and comments about the findings and their relevance and suggestions for future research.

Several of these studies are briefly highlighted in terms of their major themes. For example, some studies have pointed to differences in inattention versus hyperactive symptoms related to substance use and other outcomes among ADHD college students. For instance, Upadhyaya and Carpenter (2008) assessed 334 College undergraduates (*M* age = 20.6; Female: 61%; Caucasian: 81%) to determine the relationship of ADHD symptoms to substance use. Findings revealed that 27% of the sample reported a prior diagnosis of ADHD, with less than 25% meeting current diagnostic criteria. The number of ADHD symptoms was related to past month and past year tobacco and marijuana use, with symptoms of inattention accounting for the majority of the statistical variance. Moreover, Glass and Flory (2012) examined 889 college undergraduates ages 17 to 25-years-old (*M* age = 18.99; Males: 23%; Caucasian: 82.6%; Freshman: 51.1%) to assess ADHD symptoms and conduct disorder (CD) in relation to substance use. Findings showed that symptoms of ADHD and history of CD were positively correlated with substance use outcomes (both current and past) which included self-reported cigarette, alcohol, marijuana, and cocaine use. Categorical ADHD predicted tobacco use and alcohol-related problems. Interestingly, inattention symptoms of ADHD predicted tobacco, alcohol, and marijuana-related problems that were not predicted by hyperactive/impulsive symptoms, suggesting that inattention symptoms of ADHD may be particularly important to measure among college students when examining substance use and associated consequences.

Several other studies also looked at the impact of CD and ADHD in relation to substance use and associated consequences among emerging adults and college students. For example, Dattilo, Murphy, Van Eck & Flory (2013) assessed 889 College undergraduates (*M* age: 18.91; Female: 76%; Caucasian: 82.3%; Freshman: 50.5%) using the ChSS and CSS (ADHD symptoms), self-reported measure of history of CD, and multiple measures of substance use including the SUQ, CAPS-R, and CEOA. As has been previously shown, alcohol expectancies predicted alcohol use and related problems. However, when adding ADHD symptoms as a moderator, there was a significant interaction between positive alcohol expectancies, ADHD symptoms, and alcohol-related problems. Those with higher levels of ADHD symptoms who had positive alcohol expectancies experienced more alcohol-related problems. Moreover, ADHD symptoms moderated the relation between positive expectancies and social versus personal alcohol problems. This moderation effect remained even after controlling for CD, suggesting that ADHD symptoms alone contribute the substance use and associated consequences among college students in this sample.

In addition, while the majority of studies have employed a cross-sectional design, some researchers have reported findings using longitudinal data. For example, the study by Blasé et al., (2009) was noteworthy in that they followed participants for two years. In their second study the authors examined the relationship of ADHD and substance use and psychosocial outcomes in a sample of 846 college undergraduates from their original sample of 3,379 students (Female = 66%; Caucasian = 66%), who completed a follow-up survey during their next semester. Twenty-seven participants with ADHD responded to the follow-up survey. Findings revealed that ADHD students were more likely to increase their alcohol use from freshman to sophomore year compared to non-ADHD students. In addition, ADHD diagnosis predicted higher depression scores, suggesting that college students with ADHD may have more emotional difficulties than other students.

There have only been a few studies of ADHD students that specifically examined the issue of prescription use and misuse by diagnosis. However, in a pilot study of 1,748 college undergraduates (*M* age = 18.51; Female = 68.4%; Caucasian = 71.3%; Freshman = 80.1%) the relationship of medication use and a variety of outcomes was assessed (Mochrie, Whited, Corson, Freeman, Cellucci, & Lothes, 2016). Findings revealed that 11% of the sample reported a lifetime diagnosis of ADHD, with 40% of them reporting they were currently prescribed ADHD medication. Students with self-reported ADHD diagnosis were more likely to engage in binge drinking in the past month, consume alcohol at least 3-4x per week, and used illicit drugs more often than those without a history of ADHD. In fact, those with ADHD were misusing stimulant medication 1.81 times more often than those who were not ADHD, in the past year. In addition, among those with ADHD, individuals who were taking prescribed ADHD medication were .86 times more likely to report misusing stimulant medication than those not taking prescribed medication. This may be due to the availability of prescription stimulant medication among ADHD individuals in college. Interestingly, those with ADHD who were taking prescribed medication had marginally lower GPAs than those with ADHD not taking medication; however, there were no significant results for substance use outcomes. These results indicate that the use of ADHD prescription medication among college students may not be a protective factor for substance use risk. This is still an understudied area and future studies should attempt to examine this issue in more detail.

Table 1. Selected studies: ADHD and substance use among emerging adults and college students

Researchers	**Sample**	**Measures**	**Findings**	**Summary / Comments**
Murphy, Barkley, Bush (2002)	Emerging adults ages 17-28 yrs. (3 groups) ADHD-I (inattentive subtype) group: 36; Age: *M* = 20.1; Male: 86.1%; Education: 13yrs ADHD-C (combined subtype) group: 60; Age: *M* = 21.3; Male: 71.7%; Education: 13yrs Non-ADHD group: 64; Age: *M* = 21.1; Male: 68.8%; Education: 14.3yrs	IQ: Kauffman Brief Intelligence Test. ADHD and other Disorders: Structured Clinical Interview of Disruptive Disorders (i.e. ADHD, ODD, and CD). ADHD symptoms: ADHD Rating Scale for Adults. Psychological distress / maladjustment: Symptom Checklist (SCL-90). Substance use: Structured clinical interview.	• ADHD groups reported significantly more instances of being considered by others to be drinking too much. • ADHD groups reported using more illicit substances. • ADHD-C group reported being considered by others as “dependent” on a substance more than the ADHD-I or control group. • ADHD groups had significantly lower IQ’s and educational attainment. • ADHD-C group were significantly more likely to report history of ODD. • ADHD groups reported significantly more distress on the SCL-90. • ADHD groups reported being prescribed more psychiatric medication in the past compared to control group.	<u>Design</u>: Cross-sectional <u>Limitations</u>: Only used self-report measures for diagnoses; control group might have been functioning better than average due to no prior psychiatric diagnoses. <u>Meds</u>: 42.71% of ADHD individuals were prescribed a stimulant medication in their lifetime. Study did not report on any differences in substance use for those prescribed vs not prescribed meds. <u>Comments</u>: ADHD individuals had lower education levels and IQ scores. ADHD groups reported more substance use and psychological distress. Examining this in a college sample would add to these findings.
Upadhyaya, Rose, Wang, O'Rourke, Sullivan, Deas, & Brady (2005)	334 College undergraduates Age: *M* = 20.6 Female: 61.4% Caucasian: 84.9%	Substance use attitudes and behavior among college students: (Core Alcohol and Drug Survey) ADHD: CSS Conduct Disorder (CD) and antisocial	• 5.7% met CSS criteria for ADHD, with 3.9% having been diagnosed clinically and positive on CSS, and 21.3% having been diagnosed clinically and negative on CSS. • 22.8% were ever prescribed meds for ADHD. 3.3% on meds with current symptoms and 2.4% on meds without current symptoms. 25% of those	<u>Design</u>: Cross-sectional <u>Limitations</u>: Did not assess for medication misuse; self-reported ADHD symptoms. ADHD students with current active symptoms had greater substance use as compared to those without active symptoms. This remained consistent regardless of medication status and after controlling for CD and ASPD. <u>Meds</u>: Medication status did not matter

		personality disorder (ASPD): SCID-II ADHD Meds: self-report questions on survey	prescribed medications reported getting high at some point, and 29% reported diverting their medication at some point. • Last year tobacco and marijuana use was higher in ADHD group. Among ADHD group, those with current symptoms had greater current tobacco use than those without current symptoms. • Those with current symptoms had greater current other drug use than those without current symptoms.	in terms of substance use. Comments: ADHD current symptoms among college students may be a better predictor of substance use above and beyond ADHD diagnostic status.
Upadhyaya and Carpenter (2008)	334 College undergraduates Age: *M* = 20.6 yrs Female: 61% Caucasian: 81% Freshman through seniors (No significant difference in the number of responders based on academic standing)	Substance use attitudes and behavior among college students: (Core Alcohol and Drug Survey) ADHD: self-reported prior diagnosis; CSS - ADHD symptoms Other disorders: Survey assessed diagnostic criteria for CD and antisocial personality disorder (ASPD).	• >90% reported ever using alcohol. • >70% reported ever using tobacco and/or marijuana. • 27% reported prior diagnosis of ADHD. • <25% met criteria for current ADHD on the CSS. • 20% met criteria for CD. • 6% met criteria for ASPD. • Number of ADHD symptoms was related to past month and past year tobacco and marijuana use.	Design: Cross-sectional. Limitations: Correlational data; self-reported ADHD prior diagnosis and symptoms. Inattention symptoms of ADHD were primarily what accounted for the relationships between symptoms and substance use. Meds: Not reported. Comments: Symptoms of ADHD (especially inattentive symptoms) related to increased tobacco and marijuana smoking, but not alcohol use.
Blasé, Gilber, Anastopoulos, Costello, Hoyle, Swarzwelder, & Rabiner (2009)	Study 1: 3,379 college undergraduates (Female = 66%, Caucasian = 66%)	Study 1: Survey measures of self-reported ADHD diagnosis, medication status, ADHD	• Individuals who reported a diagnosis of ADHD reported more inattentive / hyperactive behaviors. • ADHD diagnosis predicted higher current drinking quantity	Design: Cross-sectional. Limitations: Low survey response rate; self-report data. College students with a self-reported diagnosis of ADHD reported more difficulties in academic and emotional

Study 1	Completed survey (Fall, 2006) 4.5% reported an ADHD diagnosis currently. 2.16% of the sample reported a previous ADHD diagnosis (from childhood)	symptoms (DSM-IV-TR), academic concerns, depressive symptoms (CES-D), emotional stability, social concerns, and self-report substance use	and frequency. • Marijuana and cocaine use were higher among ADHD compared to non-ADHD students. • ADHD diagnosis predicted lower GPAs and academic performance, regardless of prescribed medication. • ADHD diagnosis predicted higher depression scores.	functioning. ADHD group reported more current substance use. Meds: Among ADHD students, 73.86% were taking prescribed stimulant medication. Those on meds reported poorer overall adjustment. Comments: ADHD prescribed meds are associated with increased adjustment problems. ADHD students report higher levels of substance use than those without ADHD, regardless of medication status.
Blasé, Gilber, Anastopoulos, Costello, Hoyle, Swarzwelder, & Rabiner (2009) Study 2	Study 2: 846 college undergraduates from same sample as study 1 who completed a second survey at time 2 (Spring, 2007) 38.9% (N = 27) of the ADHD students who reported an ADHD diagnosis in study one responded to the second survey.	Study 2: Same measures as study 1	• ADHD predicted poorer academic performance and greater academic concerns during students' second year in college. • Current self-reported ADHD diagnosis did not predict social concerns, depressive symptoms, or emotional stability at time of the second survey. • ADHD predicted a higher frequency, but not quantity of alcohol use. • Alcohol use increased more from freshman to sophomore year in students with ADHD. • Those with ADHD were more likely to initiate smoking, after excluding those that had already initiated this behavior.	Design: Longitudinal Limitations: Low response rate; self-report data. ADHD diagnosis predicts increased quantity and frequency substance use and emotional / academic difficulties. These problems were consistent among individuals who reported a diagnosis of ADHD freshman year and those reporting a lifetime diagnosis of ADHD, before college. Meds: No benefits of medication use were observed. Comments: ADHD college students are at risk for higher levels of substance use and associated consequences.
Janusis and Weyandt (2010)	165 college undergraduates (62 with a disability – ADHD or other LD)	Sensation seeking - stimulation and arousal: SSS Psychological Stress: Handling	• ADHD students reported consuming less alcohol; however, used more illicit drugs. • ADHD diagnosis: Significant difference on combined measures (PSS, SSS, and SSQ	Design: Cross sectional Limitations: All students with a disability were registered with the DSS office. ADHD students were more likely to be misusing prescription stimulants and

	ADHD = 41.9% Age: M = 20 Female: 76.9% Caucasian = 91.6%	uncontrollable life events (PSS) Substance use: National College Health Assessment; SSQ (stimulant misuse)	(ADHD group scored higher compared to those without ADHD). • When assessed separately, the SSS measure was the only one that remained significant.	engaging in diversion behavior. Meds: Approx. 65% of ADHD students reported taking a prescribed stimulant medication. Comments: ADHD college students should be assessed for misusing prescribed and non-prescribed stimulant medication.
Wilens, Martelon, Joshi, Bateman, Fried, Petty, & Biederman (2011)	482 emerging adults: Data came from 2, identically designed case-control family studies of ADHD that began in childhood (7-15 yrs) and were analyzed at follow-up (10 yrs later) ADHD group: 257; Age: *M* = 20.19; Males: 52%. Control group: 225; Age: *M* = 21.96; Males: 50%. Did not report specific ethnicities; however, stated both groups were largely Caucasian.	Psychiatric and SUD assessment: SCID-IV. Also, assessed parental history of substance use. SES: 5-point Hollingshead Scale.	• ADHD group vs control group at follow-up were: 1.47x more likely to have developed a SUD, 1.5x for alcohol use disorder, 2.74x for drug use disorders, and 2.38x for cigarette smoking. • ADHD continued to be a risk factor for developing a drug use disorder and cigarette smoking after controlling for childhood conduct disorder. (ADHD group: 20% developed a SUD. Control group: 3% developed a SUD). • ADHD group initiated drug use earlier than controls. ADHD males initiated tobacco use earlier than male controls. • ODD and CD were significant predictors of all substance use disorders. • Mood disorders were significant predictors of developing a drug use disorder. • Those with persistent ADHD (assessed at follow-up) were 3x more likely to have developed a SUD than those who no longer met criteria.	Design: Longitudinal Limitations: Self-report measures; Did not examine mediation / moderation models of SUDs. There were no interaction effects with ADHD and comorbid diagnoses and substance use outcomes; however, ODD and CD predicted SUDs separately. Meds: Prior ADHD medication use was not associated with any of the substance use variables. Study did not report specific numbers. Comments: Childhood ADHD diagnosis is a risk factor for developing SUDs later on. This risk is increased if individuals have persistent ADHD into adolescence and emerging adulthood. Studies should assess both childhood and current diagnosis/symptoms of ADHD.

Baker, Prevatt, & Proctor (2012)	179 college undergraduates ADHD = 104 (Age *M* = 20.5, Male = 51%, Caucasian = 61.5% Non-ADHD = 75 (Age *M* = 20.8, Male = 50.7%, Caucasian = 69.3%)	Substance use: MAST; Items from the Barkley Structured Interview for Adult ADHD related to alcohol and drug use ADHD symptom severity: BARRS-IV – current symptoms	• 40.4% of the ADHD group reported not being able to stop drinking without a struggle after 2 drinks, and 40.4% reported not being able to stop drinking when wanting to. • ADHD group scored significantly higher on 5 items of the MAST (i.e. difficulty stopping drinking after 1-2 or when you want to, significant other complaints about drinking, problems with significant other due to drinking, fighting when drinking). • ADHD vs non-ADHD group had higher scores on MAST (i.e. total score) • Specific differences were also found between subtypes of ADHD. • Individuals with combined subtype endorsed inability to limit drinking and being arrested for drunk driving more than other subtypes.	<u>Design</u>: Cross-sectional <u>Limitations</u>: Did not assess substance use history or psychosocial functioning; correlational data. Individuals with ADHD were more likely to experience difficulties with substance use (on the MAST) compared to those without ADHD. <u>Meds</u>: 36.4% of ADHD group were taking prescribed stimulant medication and scored higher on the MAST than those not taking medication. <u>Comments</u>: ADHD college students are at a greater risk for substance use and associated consequences. Specific symptoms should be measured. Medication did not reduce substance use and associated problems.
Glass and Flory (2012)	889 college undergraduates Age: 17-25 yrs (*M* = 18.99) Males: 23% Caucasian: 82.6% Freshman: 51.1%	ADHD symptoms: ChSS; CSS; Categorical ADHD (6 or more total symptoms; 2.7% of sample). Conduct Dx history: Self-report DSM-IV-TR criteria Substance use / consequences: self-	• Symptoms of ADHD and history of CD were positively correlated with all substance use outcomes (both current and past). Categorical ADHD predicted tobacco use and alcohol-related problems • Inattention symptoms: predicted tobacco use, alcohol use, alcohol-related problems • Conduct Dx history: Predicted	<u>Design</u>: Cross-sectional <u>Limitations</u>: Categorical classification of ADHD based only on symptoms instead of diagnosis. Results were consistent even after controlling for CD. Inattention symptoms of ADHD versus hyperactive/impulsive predicted alcohol use, tobacco use, and alcohol-related problems, even after controlling for CD. Hyperactive/impulsive symptoms were not predictive of substance use in this sample.

		report questions on Lifetime and current use of cigarettes, alcohol, marijuana, and cocaine (scale from Molina and Pelham, 2003); CAPS-R (alcohol consequences)	marijuana and other illicit drug use	<u>Meds</u>: 11% of sample was prescribed ADHD meds. <u>Comments</u>: This study highlights the importance of examining ADHD symptoms (especially inattentive) in predicting substance use among college students.
Rooney, Chronis-Tuscano, & Yoon (2012)	College undergraduates ADHD = 53 (*M* age = 20.13; Males = 67.9%; Caucasian = 79.2%) Non-ADHD = 38 (*M* age = 19.6; Males = 50%; Caucasian = 71.1%)	ADHD assessment: CAARS; Diagnostic interview; K-SADS (ADHD and Conduct dx); Childhood symptom scale – self and other. Substance Use: AUDIT; DUDIT; CORE.	ADHD associated with: • Earlier initiation of tobacco use • Higher scores on AUDIT (dangerous alcohol use and dependence item) • Greater frequency of alcohol-related negative consequences • Age of first use of marijuana and other illicit drugs, and higher quantity of current use • ADHD were 3.3x more likely to have ever used marijuana, 4.5x to have ever used illicit drugs	<u>Design</u>: Cross-sectional <u>Limitations</u>: Relatively small sample; only used self and other report measures for ADHD. Results remained consistent after controlling for childhood CD diagnosis. Alcohol use did not differ between groups. ADHD medication use did not impact substance use or associated consequences. <u>Meds</u>: Not reported. <u>Comments</u>: College students with ADHD are at risk for earlier onset of substance use and associated consequences, even after controlling for conduct disorder.
Dattilo, Murphy, Van Eck & Flory (2013)	889 College undergraduates Age: *M* = 18.91 Female: 76% Caucasian: 82.3% Freshman: 50.5%	ADHD: ChSS and CSS Childhood CD: Included as a self-report measures in the ChSS. Alcohol use: SUQ Problems associated with alcohol use: CAPS-R Positive alcohol	• 3.3% of sample met criteria for ADHD. • Alcohol expectancies predicted alcohol use and related problems. • When adding ADHD symptoms as a moderator, there was a significant interaction between positive alcohol expectancies, ADHD symptoms, and alcohol-related problems. Those with	<u>Design</u>: Cross-sectional <u>Limitations</u>: Self-report measures, except parent report; cross-sectional-design. The moderating effect of ADHD symptoms remained after controlling for CD. ADHD symptoms did not moderate the relationship between positive expectancies and alcohol use and/or personal alcohol-related problems. <u>Meds</u>: Not reported. <u>Comments</u>: ADHD symptoms are important to examine among college

		expectancies: CEOA	higher levels of ADHD symptoms who had positive alcohol expectancies experienced more alcohol-related problems. • ADHD symptoms moderated the relation between positive expectancies and social vs. personal alcohol problems.	students in relation to positive alcohol expectancies and associated consequences of alcohol use.
Tamm, Epstein, Lisdahl, Molina, Tapert, Hinshaw, & ... Swanson (2013)	Emerging adults from the Multimodal Treatment Study of ADHD (MTA). Participants entered the study between 7-9 yrs old and data is a follow-up between 14-16yrs post initial visit 4 groups based on ADHD diagnostic status and marijuana use status ADHD non-user group: 45; Age: *M* = 24.6; Male: 73.3%; Caucasian: 60% ADHD user group: 42; Age: *M* = 24.4; Male: 92.9%; Caucasian:	Substance use: SUQ Neuropsychological testing: Hopkins Verbal Learning Task (HVLT), Iowa Gambling Task (IGT Net), Trail Making Test (TMT), HVLT Recall, Go/NoGo (GNG), Delis-Kaplan Color-Word Interference Task (D-KEFS), and Paced Auditory Serial Addition Test (PASAT) No participants took ADHD stimulant medication on the day of testing	• ADHD groups performed significantly worse on all of the neuropsychological testing except HVLT (delayed recall), TMT, and the GNG task. • ADHD-user group reported initiating cannabis use younger than control-user group. • Cannabis users performed more poorly on the IGT Net score compared to non-users; however, there were no other significant main effects for cannabis use and neuropsychological tests. • Early onset cannabis user performed more poorly than late-onset users on all neuropsychological tests. • There were no significant ADHD x cannabis use interactions	Design: Longitudinal Limitations: Did not reassess at follow-up if participants still met criteria for ADHD; Did not assess alcohol and other drug use besides cannabis use; Small sample size. Individuals with ADHD showed deficits (lower scores) on measures of impulsivity, working memory, and verbal memory. However, cannabis users only showed deficits in decision making. Meds: 4% of ADHD non-cannabis-users reported they always take ADHD stimulant prescription meds. 7% of ADHD users reported always taking ADHD meds, with 2% reporting using sometimes. Non-ADHD groups did not report med use. Comments: Interestingly, about half of the individuals diagnosed with ADHD in childhood went on to use cannabis, suggesting a link between childhood ADHD diagnosis and cannabis use initiation as adolescents and emerging adults. Overall, findings suggest that ADHD has more significant effects on executive functioning than cannabis use. Future studies should assess persistent symptoms of ADHD in relation to

	57.1%. Control non-user group: 21; Age: *M* = 23.4; Male: 66.7%; Caucasian: 57.1%. Control user group: 20; Age: *M* = 23.7; Male: 85%; Caucasian: 70%.			cannabis use among emerging adults as well as integrate alcohol and other drug use into their assessment.
Van Eck, Markle, Dattilo, & Flory (2014)	627 College undergraduates Age: 18-25 (*M* = 20.23) Female: 60% Caucasian: 47% Freshman: 43%	ADHD symptoms: CSS Conduct Problems (CP): SRD Perceived peer use and tolerance: Adapted from Chassen et al. (2003) from Monitoring the Future Study. Substance use: SUQ	• ADHD symptoms and CP associated with: alcohol and marijuana use, as well as peer perception of substance use. • Perceived peer alcohol use mediated ADHD symptoms and alcohol use. • Perceived peer marijuana use mediated ADHD symptoms and marijuana use. • Perceived peer illicit drug use mediated ADHD symptoms and illicit drug use.	<u>Design</u>: Cross-sectional <u>Limitations</u>: Cross-sectional design, ADHD diagnostic criteria not measured. Higher levels of self-reported ADHD symptoms and CP correlated with higher quantity of alcohol use, marijuana use, and peer perceptions of substance use. <u>Meds</u>: Not reported. <u>Comments</u>: Peer influence mediated ADHD symptoms and substance use. Peer perceptions and influence should be assessed among ADHD, substance using college students.
Mesman (2015)	192 college undergraduates Age: 18-34 (*M* = 19.2) Female: 52.6% Caucasian: 53.1% African American: 37.5% Freshman: 81.3%	ADHD: BARRS-IV Antisocial: Antisocial traits, Personality Assessment Inventory (Morey, 1991) Alcohol use: AUDIT	• Inattention symptoms were related to alcohol-related problems, even when controlling for antisocial behavioral traits. Hyperactivity/impulsivity symptoms were not related to alcohol-related problems after controlling for antisocial behavior.	<u>Design</u>: Cross-sectional <u>Limitations</u>: cross-sectional design; did not assess ADHD diagnosis. Inattention symptoms of ADHD were more predictive of alcohol problems than hyperactivity / impulsivity symptoms. <u>Meds</u>: Did not report. <u>Comments</u>: The findings indicate that Hyperactivity/impulsivity symptoms are related to behavioral issues such as CD or antisocial traits.

Rooney, Chronis-Tuscano, & Huggins (2015)	College Undergraduates ADHD = 48 (*M* age = 20.10; Female = 56.3%; Caucasian = 66.7%) Non-ADHD = 52 (*M* age = 19.04; Female = 57.7%; Caucasian = 78.8%)	ADHD/Other psychiatric disorders: ADHD module of K-SADS; CAARS-LV; MINI (Structured diagnostic interview). Substance use: AUDIT; CORE Disinhibition: (DIS from the sensation seeking scale; Zuckerman, 1994)	• ADHD group had significantly higher rates of current and past alcohol abuse dx and past MDD. • AUDIT total and cutoff scores were significantly higher in ADHD group. • ADHD group reported more alcohol consequences on the CORE. • ADHD group had higher DIS scores. • Disinhibition mediated ADHD and specific alcohol consequences.	<u>Design</u>: Cross-sectional <u>Limitations</u>: Cross-sectional design with mediation analyses; small sample; self-report measures. 46.8% of individuals in the ADHD group met criteria for alcohol abuse in their lifetime, 36.3% currently. <u>Meds</u>: Not reported. <u>Comments</u>: This study lends support for mediation/moderation models of substance use consequences among ADHD college students, with sensation seeking (DIS) playing a unique role.
Mochrie, Whited, Corson, Freeman, Cellucci, Lothes, (2016)	1,748 College Undergraduates Age: *M* = 18.51 Female: 68.4% Caucasian: 71.3% Freshman: 80.1%	ADHD: Self-reported diagnosis and medication use. Substance use: Self-reported quantity / frequency	• 11% reported a lifetime diagnosis of ADHD, with 40% ADHD reporting being currently prescribed an ADHD medication. • 48% reported binge drinking. • 20% reported problematic drinking (i.e. $\geq$ 40 standard drinks per months). • 41.6% reported using an illicit substance in the past year. • Students with self-reported ADHD were more likely to engage in binge drinking in the past month and consumed alcohol at least 3-4x per week and used illicit drugs more often than those without ADHD. • Those with ADHD who were taking prescribed medication had marginally lower GPAs than those with ADHD not taking medication.	<u>Design</u>: Cross-sectional <u>Limitations</u>: Self-reported ADHD diagnosis and medication use; Did not measure ADHD symptoms. ADHD self-reported diagnosis is associated with binge drinking and higher frequency of alcohol use, which is discrepant from some other findings; however, symptoms of ADHD were not measured. <u>Meds</u>: ADHD prescription med use did not change results of substance use. <u>Comments</u>: It is important to examine both ADHD past diagnosis and symptoms in relation to substance use. Prescribed medication use among this population needs to be assessed further.

Bergman, Owens, Kelter, & Kong (2016)	105 emerging adults: ADHD group: 23 Male: 78.2% Hispanic: 43.4%; Caucasian: 21.7% Non-ADHD group: 82 Male: 56.1% Hispanic: 54.4% African-American: 20.3%. -Did not meet criteria and reported <3 ADHD symptoms. All recruited from a GED program	ADHD and other diagnoses: Modified ADHD Interview for Adolescents (Modified from K-SADS); Parents' Rating Scale (PRS). Substance Use Disorder: SCID-NP. This was also used to assess other Axis I disorders. ASPD: SCID-II.	• Among ADHD group: 59.1% met criteria for ASPD, and 39.1% for a depressive disorder. • Among ADHD group: 54.5% met criteria for an Alcohol Use Disorder, 45.5% for Marijuana, and 22.7% for Cocaine. • ADHD group had significantly higher rates of Alcohol and Cocaine Use Disorders. • ADHD group had significantly higher rates of Depressive disorders and ASPD. • After controlling for ASPD, the relationship between ADHD and Alcohol Use Disorder was no longer significant.	Design: Cross-sectional Limitations: Generalizability: Approx. half of the sample with ADHD met criteria for an AUD. Further, there are clear differences between emerging adults with and without ADHD in terms of Substance Use Disorders and other mental health disorders. Meds: Only 10% reported ever taking a prescribed ADHD med. Comments: ASPD likely plays a mediating role in the relationship between ADHD and AUDs. ASPD and/or CD symptoms should be assessed among emerging adults with ADHD and comorbid SUDs.

To summarize, these studies all support findings from general literature that young adults with ADHD have earlier onset of initiation into tobacco and alcohol use and are at greater risk of substance abuse, both for alcohol (not always consistent) and especially illicit drugs. Although less often measured separately, the available studies also suggest this substance use is connected to negative consequences. The studies varied methodologically, although most were cross-sectional, and many relied on self-reported diagnosis or symptoms without diagnostic collaboration.

There are several themes that emerge from the limited research on ADHD and substance use among emerging adults and college students. First, among this population there is a relationship between ADHD diagnosis and substance use. Specifically, the literature shows that individuals with a history of diagnosed ADHD engage in more substance use overall (Blasé, Gilber, Anastopoulos, Costello, Hoyle, Swarzwelder, & Rabiner, 2009; Dattilo, Murphy, Van Eck, & Flory, 2013). Second, current ADHD symptoms are associated with increased use of substances, with a particular emphasis on symptoms of inattention versus hyperactive/impulsive symptoms (Baker, Prevatt, & Proctor, 2012; Murphy, Barkley, & Bush, 2002). It seems that symptoms of inattention are better predictors of substance use among college students than other types of symptoms (Glass & Flory, 2012) and may be a better predictor than ADHD diagnosis. This might be a result of fewer individuals with ADHD at this age exhibiting current impulsive/hyperactive symptoms. However, it was also reported that individuals with a combined sub-type of ADHD were more likely to meet criteria for a SUD than those with just inattentive or hyperactive/impulsive (Murphy, Barkley, & Bush, 2002). Further, it does seem that individuals with a history of ADHD who are experiencing persistent symptoms into adolescence and emerging adulthood are at a greater risk of increased substance use and associated consequences than those who do not (Wilens, Martelon, Joshi, Bateman, Fried, Petty, & Biederman, 2011). Interestingly, the majority of research points to symptoms of ADHD being related to substance use other than alcohol (e.g., tobacco, marijuana, etc.) (Upadhyaya & Carpenter, 2008). Perhaps, regardless of ADHD status there is an increase in quantity and frequency of alcohol use among college students, influenced by campus and peer norms.

ADHD diagnosis and symptoms also predict substance use associated consequences among emerging adults and college students (Mesman, 2015; Rooney, Chronis-Tuscano, & Huggins, 2015). Individuals who exhibit higher levels of ADHD symptoms or meet criteria for an ADHD diagnosis report experiencing more substance-related consequences, both in academics and in psychosocial functioning. Further, ADHD has been associated with deficits in executive functioning among this population (Tamm, Epstein, Lisdahl, Molina, Tapert, Hinshaw, & ... Swanson, 2013), that likely interfere with a student's ability to function at a high level academically. In addition, the literature shows a link between ADHD and higher levels of psychological distress among college students with ADHD and concurrent substance use when examined separately. Interestingly, there are no studies to date that have reported interactions between ADHD and substance use and their association to psychological/academic distress.

Next, a history of Conduct Disorder (CD), conduct problems, and/or Antisocial Personality Disorder (ASPD) is also associated with an increased risk for substance use and associated consequences among emerging adults and college students (Bergman, Owens, Kelter, & Kong, 2016; Rooney, Chronis-Tuscano, & Yoon 2012; Wilens et al., 2011). Interestingly, interaction effects are generally not reported between ADHD and comorbid disorders on substance use among emerging adults, although in some studies these symptoms are found to mediate the relationship to substance use. However, even when controlling for these comorbid and/or historical disorders and/or symptoms, there are still significant findings for ADHD on substance use (Van Eck, Markle, Dattilo, & Flory, 2014; Wilens et al., 2011). Therefore, studies should examine the impact of controlling for CD and/or ASPD when examining college student substance use; however, the unique role of ADHD and its symptoms cannot be ignored.

ADHD has been shown to be a risk factor across a number of substances; therefore, it is important that research in this area look at this risk separately across a range of substances most used by young adults (i.e., especially alcohol, marijuana, and non-prescribed stimulants). Studies examining ADHD and substance abuse risk in college students have often not included stimulant misuse, which generally has been looked at among all college students. Some studies also do not inquire about prescription use. However, the consensus seems to be clear among those that have examined this variable; medication use among individuals with ADHD apparently does not impact or protect against substance use (Blasé et al., 2009; Upadhyaya, Rose, Wang, O'Rourke, Sullivan, Deas, & Brady, 2005). In fact, some research suggests that college students with ADHD are more likely to misuse stimulant medication compared to students without ADHD, regardless of their medication status (Janusis & Weyandt, 2010). In some cases, medication use is associated with increased use or problems in functioning (e.g., Baker et al., 2012; Mochrie et al., 2016) and may be an indicator of problem severity.

It is now clear that students with ADHD who enter college are at a greater risk for using substances, in particular alcohol and marijuana (Hartung et al., 2013; Rooney et al., 2012; Mesman, 2015). They may experience both increased substance use as well as associated negative consequences. However, not all or perhaps even most college students with ADHD have difficulties with substance use. While it is difficult to estimate the percentage of ADHD students likely to have substance abuse difficulties, from the studies that report percentages (Mochrie et al., 2016, Rooney et al., 2015), it is reasonable to suggest perhaps 30% or more. There also is limited research assessing differences in substance use and associated consequences within ADHD college student samples. The majority of studies have examined differences in substance use and associated consequences between individuals with and without ADHD. However, this fails to account for within-subject differences among ADHD college students and specifically what predicts their increased substance use involvement. The few available studies included in *Table 1* examining potential mediators highlight possible roles for disinhibition, peer influences, and positive substance use expectancies. These studies are discussed below reviewing predictors of substance use.

General and ADHD-Specific Predictors of Substance Use

This section of the paper reviews possible predictors of substance use and negative consequences among college students with ADHD. For organizational clarity, they are discussed as common or general predictors which have been related to substance use in college students regardless of ADHD status and those that are more specifically associated with ADHD diagnosis, although some might be viewed as overlapping.

General Predictors of Substance Use

General predictors of substance use include a history of conduct disorder, alcohol and other drug use history, peer influence on alcohol and other drug use, alcohol and other drug use expectancies, and sensation seeking. All of these factors have research to support their link to substance use and associated consequences. The study findings are mainly consistent and show positive relationships between these different predictors and increased substance use and negative consequences. Each of these will be discussed in some detail. Where available, studies including ADHD participants are highlighted.

History of Conduct Disorder. It is well known that individuals with a history of Conduct Disorder (CD) are at a greater risk for using substances, developing substance use disorders, and experiencing substance use negative consequences. A history of CD is strongly related to substance use disorders among adolescents and emerging adults (Hopfer, Salomonsen-Sautel, Mikulich-Gilbertson, Min, McQueen, Crowley, ... & Hoffenberg, 2013). Other studies have illustrated a link between disinhibition and psychopathology (such as symptoms seen in CD) with an earlier onset of alcohol use (McGue, Iacono, Legrand, Malone, Elkins, 2001). There is also literature showing that early conduct problems are a risk factor for marijuana use among college students (Falls, Wish, Garnier, Caldeira, O'Grady, Vincent, & 2011).

However, it may be difficult to diagnose CD when an adolescent is using substances. Many individuals with a substance use disorder exhibit behavior that may mimic CD, especially in adolescence or young adulthood. In turn, behavioral and conduct problems may lead to increased use of substances, producing a cyclical relationship between substance use and CD (White, Loeber, Stouthamer-Loeber, & Farrington, 1999). Therefore, it is not always easy to separate out CD in the presence of adolescent substance use. Some research suggests that approximately half of individuals who initially meet criteria for CD in young adulthood only display these behaviors due to alcohol and drug use (Hopfer et al., 2013).

There is also considerable research relating ADHD and CD and/or conduct problems (Pliszka, 1998). Studies show that many children who exhibit symptoms of one of these disorders also display overlapping symptoms of the other. Further, there are increased concerns and needs with children experiencing both ADHD and CD that impact society, such as parents and teachers expending extra time and energy with them (Erskine, Ferrari, Polanczyk, Moffitt, Murray, Vos, ... & Scott, 2014). There is also evidence to suggest that children who have comorbid ADHD and CD are at a greater risk for negative consequences as adults, including committing crimes (Mordre, Groholt, Kjelsberg, Sandstad, & Myhre, 2011).

What is less clear is the role CD plays in accounting for the link between ADHD and substance use. Some research suggests that the link between ADHD and substance use is actually better accounted for by history of CD (Lynskey & Hall, 2001). Consequently, many studies have controlled for comorbid CD when assessing substance use among ADHD populations and found that many of the outcomes for substance use were no longer significant (Flory & Lynam, 2003; Torok, Darke, & Kaye, 2012), arguing that history of CD is more important than ADHD symptoms when looking at substance use. However, there are mixed results on this issue. In contrast, there are several studies that reveal ADHD as a unique predictor of the onset of substance use after CD is controlled for (Elkins, McGue, & Iacono, 2007).

Some studies of emerging adults use CD or conduct problems as controlling variables when examining ADHD in relation to substance use among emerging adults and college students. For example, Upadhyaya et al. (2005) examined 334 College undergraduates (*M* age = 20.6; Female: 61.4%; Caucasian: 84.9%) to assess ADHD and substance use. After controlling for CD, findings indicated that students with ADHD engaged in more past year tobacco use and other drug use than those without ADHD. Moreover, those with ADHD who endorsed current symptoms reported higher levels of substance use than those without current symptoms even after controlling for CD, suggesting that ADHD might be a unique predictor of substance use. Further, Rooney et al. (2012) examined differences among college undergraduates with ADHD (N = 53; *M* age = 20.13; Male = 67.9%; Caucasian = 79.2%) and those without ADHD (N = 38; *M* age = 19.6; Males = 50%; Caucasian = 71.1%) in terms of substance use. Similar to findings from Upadhyaya et al. (2005), the authors controlled for CD and still found that students with ADHD were 3.3x more likely to have ever used marijuana and 4.5x to have ever used illicit drugs compared to those without ADHD. This continues to suggest that ADHD in of itself may be a unique predictor of college student substance use, even after controlling for CD.

In addition, Mirza & Bukstein (2011) discuss the reciprocal relationship between substance use disorders and CD and how they likely exacerbate symptoms of one another. It is possible, that CD is a mediator between ADHD and substance use disorders. Therefore, it is essential to assess both CD and/or conduct problems and ADHD when examining substance use and associated consequences.

Alcohol and Other Drug Use History. Substance use history is often found to be a good predictor of current use. Among college students, reported binge drinking in high school is significantly correlated with binge drinking in college (Wechsler, Dowdall, Davenport, & Castillo, 1995), suggesting that for many students heavy drinking begins before entering college. However, as noted above, research suggests that many students tend to increase the quantity and frequency of alcohol use when they come to college due to less parental supervision and greater overall freedom (Borsari, Murphy, & Barnett, 2007). Interestingly, it is estimated that approximately 40% of students who enter into college as non-drinkers begin drinking their freshman year (Reifman & Watson, 2003). Nevertheless, many freshmen come to college with established drinking patterns (Reifman & Watson, 2003; Wood, Read, Mitchell, & Brand, 2004). These patterns are often maintained or increased which may relate to increased number of negative consequences due to alcohol use in college.

It is clear that alcohol use history is important in predicting current use among college students. It is likely that individuals who are drinking in high school are at a greater risk for alcohol associated negative consequences in college. For example, Hingson and colleagues found that individuals who began drinking before age 14 years were more likely to experience alcohol dependence at some point in their lifetime and within 10 years of first drinking in a sample of 43,093 adults (Hingson, Heeren, & Winter, 2006). Thus, alcohol use history assessment is necessary when examining college students to determine risk of associated consequences and possible development of substance use disorders.

In addition to alcohol use history; previous drug use patterns are also important to assess in college populations. Research similarly has demonstrated that past use (i.e., high school) of a variety of illicit substances predicts college use of alcohol and other drugs (Merline et al., 2004). There has also been research demonstrating that history of marijuana use can predict future negative consequences, including psychiatric symptoms (Ferdinand, Sondeijker, Van Der Ende, Selten, Huizink, & Verhulst, 2005), which may make it particularly difficult to succeed in college. Misuse of prescription stimulants is associated with alcohol and other drug use as well as associated negative consequences (Lakhan & Kirchgessner, 2012). Interestingly, prescribed stimulant medication use history does not appear to effect substance use among college students with ADHD (Blasé et al., 2009). There is little documented about history of substance use and its impact on current use among college students with ADHD, although it would be expected to also be predictive within this group.

Peer Influence on Alcohol and Drug Use. There is considerable research that directly points to the influence of peers on alcohol and drug use among adolescents and college students. Moreover, peer influence appears to be a significant factor in the increased use of substances upon entering college. Many college students are faced with more opportunities to use alcohol and other drugs and peer pressure likely plays a role in initiation of substance use (Skidmore et al., 2016). Particularly among first-year college students, the role of peer norms significantly predicts substance use (Turrisi, Padilla, & Wiersma, 2000). Students may be at an especially high risk for substance use and associated consequences if they are surrounded by peers that engage in these behavior patterns. Interestingly, Van Ryzin, Fosco, and Dishion, (2012) studied a sample of 928, 12 to 23-year-olds, to determine social influences on substance use from adolescence through early adulthood. Findings revealed that both family and peer influence predicted adolescent substance use. However, when examining young adults (college age) the only significant predictor was negative peer associations (i.e., peers who use substances and influence friends to use with them). These findings highlight the importance of peer influence on substance use, especially beyond adolescence into college and young adult years.

In addition, perception of peer substance use increases risk for initiating and maintaining substance use among college students (Skidmore et al., 2016). There are numerous studies showing that college students tend to overestimate their peers' approval of substance use and the quantity and frequency with which their peers are using drugs (Boot, Dahlin, Lintonen, Stock, Van Hal, Rasmussen, & McAlaney, 2013). This likely plays a major role in initiation and maintenance of use among college students. Moreover, students with other mental health problems may be particularly susceptible to this influence. For example, Villarosa and colleagues found that out of 562 college undergraduates, those that scored higher on measures of social anxiety tended to be more susceptible to peer influence on substance use (Villarosa, Madson, Zeigler-Hill, Noble, & Mohn, 2014). In fact, those that reported higher levels of social anxiety and greater susceptibility towards peer influence also reported more harmful drinking, higher levels of alcohol-related negative consequences, and fewer behavioral (protective) strategies.

The impact of peer associations has directly been examined as a mediator of alcohol risk among ADHD college students. For instance, Van Eck, Markle, Dattilo, & Flory, (2014) assessed 627 college undergraduates aged 18-25 (*M* age = 20.23; Female = 60%; Caucasian = 47%; Freshman = 43%) to examine peer influence as a mediator of alcohol risk among ADHD college students. Results showed that ADHD symptoms and conduct problems were both associated with alcohol and marijuana use as well as peer perception variables. Further, perceived peer alcohol and marijuana use mediated ADHD symptoms and actual use of these substances. This study demonstrates the importance of peer perceptions and influence on substance use, particularly among ADHD college students.

Clearly, peer influence is an importance factor in assessing college student substance use. There is less known about the role of peer influence among ADHD college students and the role it plays in substance use associated consequences, although negative consequences would likely also increase with use. Presumably, ADHD college students who report higher levels of peer influence in terms of their substance use would also have higher rates of negative consequences and psychosocial and academic problems generally than those that don’t.

Alcohol and Other Drug Expectancies. There are many motives that help to explain why individuals use alcohol and other drugs. Among youth, social motives tend to be one of the main reasons for engaging in alcohol use (Kuntsche, Knibbe, Gmel, & Engels, 2005). There is also considerable related literature suggesting the importance of positive alcohol and drug expectancies. Expectancies are the cognitive, affective, and behavioral outcomes an individual expects to experience when using alcohol or other drugs. They are considered learned cognitive associations that convey substance use risk through greater accessibility in memory. College student expectancies for alcohol and other drug use have been directly associated with increases in the quantity/frequency of their use as well as associated negative consequences (Carey, 1995; Gilles, Turk, & Fresco, 2006; Neighbors, Geisner, & Lee, 2008).

Cox and Klinger (1988) proposed a motivational model of alcohol use, which was revised in 2004 (Cox & Klinger, 2004). In this model, there are cognitive and social determinants of drinking which include: enhancement drinking motives, coping motives, social reinforcement drinking motives, and conformity motives. Enhancement drinking motives describe positive alcohol expectancies, which may be particularly useful to examine in a college population.

For example, Rohsenow (1983) examined alcohol expectancies among 150 college students (*M* age = 19.24; Male = 85) using a revised Alcohol Expectancy Questionnaire (R-AEQ). Findings revealed that most students endorsed positive alcohol expectancies for themselves, and those that were classified as social drinkers expected others to be more strongly affected by alcohol than themselves. More recently, in a study of 535 college undergraduates' ages 18 to 24 years old, researchers found that drinking motives, outcome expectancies, and perceived norms were all crucial predictors of college student alcohol use (Wahesh, Lewis, Wyrick, & Ackerman, 2015). Further, drinking motives partially mediated the relationships between outcome expectancies and the intensity of alcohol use as well as alcohol-related negative consequences, suggesting that alcohol and other drug use expectancies play a unique role in college student substance use.

Expectancies are not just a prevalent factor in alcohol use, there is substantial literature showing expectancies influence drug use. For instance, a study of 704 college students (*M* age = 19.23) across two universities found that cocaine and marijuana expectancies were related to the use of these drugs (Schafer & Brown, 1991). Specifically, individuals who used cocaine and marijuana endorsed higher levels of positive outcome expectancies compared to those that did not use these drugs. More recent studies have found similar results. Positive expectancies for marijuana use among adolescents, emerging adults, and college students have been well demonstrated (Brackenbury & Anderson, 2016; Kristjansson, Agrawal, Lynskey, & Chassin, 2012; Brown et al., 1991). For example, Brakenbury and Anderson (2016) examined marijuana use and cessation expectancies among 357 college student lifetime marijuana users. Results showed that marijuana use and cessation expectancies contributed unique variance to the prediction of marijuana use in a regression model. Specifically, individuals with positive expectancies of marijuana use and/or negative expectancies of cessation engaged in higher levels of current use than those that had negative expectancies of use and/or positive expectancies of cessation.

It is evident that alcohol and other drug use expectancies significantly contribute to substance use patterns among college students. Both positive and negative expectancies can influence increased or decreased overall substance use, although positive expectancies have been found to be more influential among emerging adults (McBride, Barrett, Moore, & Schonfeld, 2014). Interestingly, as previously discussed, ADHD symptom severity moderates this relationship among college students, suggesting a substantial interaction between alcohol expectancies, associated consequences, and ADHD symptoms (Dattilo, Murphy, Van Eck, & Flory, 2013).

Harty and colleagues examined marijuana use expectancies among a group of ADHD young adults (N = 190; *M* age = 20.21, Male = 84.9%) and those without ADHD (N = 116; *M* age = 19.81; Male = 86.9%) (Harty, Pedersen, Gnagy, Pelham, & Molina, 2015). Interestingly, the ADHD individuals reported lower positive expectancies (i.e., social enhancement, tension reduction) and negative expectancies (i.e., cognitive and behavioral impairment) than the non-ADHD group. Moreover, positive marijuana expectancies were predictive of marijuana use regardless of ADHD status. These findings are somewhat discrepant from other literature, showing that ADHD individuals have higher levels of expectancies for alcohol and other drug use, suggesting that marijuana expectancies need to be examined in greater detail to determine their impact among ADHD individuals. Thus, the present study clarified the role of positive alcohol and other drug expectancies in substance use and associated consequences among ADHD college students.

Sensation Seeking. A number of personality factors are thought to help explain college student substance use. One of the most interesting, sensation seeking, is considered a temperament trait that has been linked to substance use. Sensation seeking, as defined by Zuckerman (2013), is the search for experiences and feelings that are considered varied, novel, complex and intense. Moreover, high sensation seekers are considered individuals who engage in physical, social, legal, and financial risky behavior, which can include substance use. College students with high levels of sensation seeking may be at a greater risk for substance use problems during this developmental period.

For example, a recent study examined 1,253 college students (*M* age = 18.1; Female = 51.5%; Caucasian = 73.1%), to determine the effects of sensation seeking and parental monitoring on the probability of alcohol or marijuana dependence during the first year of college (Kaynak, Meyers, Caldeira, Vincent, Winters, & Arria, 2013). Results indicated that high levels of sensation seeking were associated with increased risk for alcohol and cannabis dependence during freshman year of college. Further, participants self-reported the level of parental monitoring they received during their senior year of high school and findings suggested that higher levels of parental monitoring had a direct effect on reducing risk for alcohol, but not marijuana dependence during freshman year of college. Interestingly, there was no interaction effect, indicating, that sensation seeking personality alone is important in the development of substance use disorders among beginning college students.

Other research points to the influence of sensation seeking on drinking frequency among college students. For instance, Cyders and colleagues found that among 418 first-year college students, those that reported higher levels of sensation seeking also engaged in alcohol consumption significantly more often than those that did not (Cyders, Flory, Rainer, & Smith, 2009). Further, a recent study found that higher levels of both impulsivity and sensation seeking predicted more alcohol-related negative consequences among college freshman (Kazemi, Flowers, Shou, Levine, & Van Horn, 2014). Interestingly, positive alcohol expectancies mediated the relationship between sensation seeking and consequences, suggesting that both sensation seeking and positive expectancies should be examined when assessing college student substance use and associated consequences.

However, there is limited research to date to assess these relationships among ADHD college students. A sensation-seeking temperament is often seen as accompanying ADHD. In terms of college students with ADHD, sensation seeking may often accompany the disorder, which raises the question; what role might sensation seeking play in ADHD college student substance use? A study conducted by Graziano and colleagues attempted to answer this question with 555 college students (ages 18 – 29-years-old) who completed self-report measures of both ADHD symptoms and sensation seeking (Sensation Seeking Scale; SSS; Zuckerman, 1994), as well as risky health (i.e., substance use), driving, and financial behaviors (Graziano, Reid, Slavec, Paneto, McNamara, & Geffken, 2015). Their findings indicated that severity of ADHD symptoms and sensation seeking separately predicted more substance use in this sample. However, there was an interaction effect such that the relationship between ADHD symptom severity and substance use was even greater when individuals were high on sensation seeking, suggesting that an individual with ADHD with high levels of sensation seeking may be at a particular risk of substance use.

In addition, Rooney, Chronis-Tuscano, and Huggins (2015) examined ADHD, sensation seeking, and substance use among college undergraduates with ADHD (N = 48; *M* age = 20.10; Female = 56.3%; Caucasian = 66.7%), and those without ADHD (N = 52 *M* age = 19.04; Female = 57.7%; Caucasian = 78.8%). Findings revealed that the ADHD group had significantly higher rates of current and past alcohol abuse diagnoses as well as depression diagnoses. Moreover, the AUDIT total scores were significantly higher in ADHD group, with this group also reporting more alcohol consequences. Interestingly, the ADHD group demonstrated higher scores on the Disinhibition scale of the Sensation Seeking Scale by Zuckerman, with Disinhibition mediating ADHD and specific alcohol consequences. Taken together, these findings suggest that college students with ADHD likely have higher scores on sensation seeking, which interact with ADHD symptoms in relationship to substance use as well as associated consequences.

ADHD Specific Predictors of Substance Use

In addition to general predictors of substance use and associated consequences (outlined above), there are some factors that might be considered ADHD specific predictors. These include type and severity of ADHD symptoms, impulsivity, and executive functioning deficits which all might be hypothesized to contribute unique variance in the prediction of substance use and associated consequences among ADHD individuals.

Severity of ADHD Symptoms. ADHD symptom severity can impact a number of areas of functioning as well as substance use patterns. In particular, the role of ADHD symptoms in substance use has been studied in college student samples. Upadhyaya and Carpenter (2008) examined 334 college students (*M* age = 20.6; Female: 61%; Caucasian: 81%) to assess the role of ADHD current symptoms in predicting alcohol and other drug use. This study used the total number of ADHD symptoms endorsed (both inattentive and impulsive/hyperactive) as a measure of symptom severity. The study concluded that the number of current ADHD symptoms was significantly associated with the frequency of alcohol, tobacco, and marijuana use in the past month as well as tobacco and marijuana use in the past year.

In addition, Mesman (2015) examined the relationship of ADHD symptoms and substance use among 192 college undergraduates (Age: 18-34; *M* age = 19.2; Female: 52.6%; Caucasian: 53.1%; African American: 37.5%; Freshman: 81.3%). Findings indicated that ADHD inattention symptoms were related to alcohol-related problems, while Hyperactivity/impulsivity symptoms were not related to any of these variables, regardless of whether controlling for antisocial behavioral traits. This suggests that ADHD severity of symptoms (particularly inattentive) may be useful when examining the relationship of ADHD to substance use and associated consequences among college students.

Further, Glass and Flory (2012) examined 889 (age = 17 to 25-year-old) college students who completed a survey to assess the impact of ADHD symptoms on substance use. Participants reported childhood and current symptoms of ADHD using the Childhood Symptom Scale (ChSS) and the Current Symptoms Scale (CSS), respectively, as well as history of CD. Findings indicated that symptoms of ADHD and CD were separately correlated with increased substance use. Further, analyses revealed that current ADHD inattention symptoms predicted alcohol use after controlling for CD. This suggests that, at least for alcohol, ADHD symptom severity may play a unique role in consumption patterns. Interestingly, this study did not replicate these findings with illicit drugs (i.e., marijuana and cocaine use).

A unique study by Arria and colleagues examined marijuana and non-prescription stimulant use among 470 college students without any history of a medical diagnosis of ADHD, who self-reported ADHD symptom severity on the Adult ADHD Self-Report Scale (ASRS) (Arria, Garnier-Dykstra, Caldeira, Vincent, O'Grady, Wish, 2011).

The participants were subdivided into one of three comparison groups (i.e., persistent non-medical users of prescription stimulants (N = 112); persistent marijuana users but who did not use prescription stimulants non-medically (N = 163); nonusers of both illicit and prescription drugs (i.e., did not use drugs) (N = 195)). Results showed that ADHD symptoms were associated with being a persistent non-medical user of prescription stimulants after controlling for race, ethnicity, sex, socioeconomic status, and other illicit drug use. ADHD inattention symptoms seemed to account for the majority of the predictive power. Interestingly, there were no associations between ADHD symptoms and being a persistent marijuana user. Thus, ADHD symptoms (particularly inattention) were associated with non-medical use of prescription stimulants and should be examined further in college student samples.

Finally, studies show that ADHD symptoms can be associated with negative consequences in a variety of areas. For example, symptoms of inattention predict poorer academic status and greater likelihood of academic probation among college students (Frazier, Youngstrom, Glutting, & Watkins, 2007). Further, many young adults with ADHD, self-report their symptoms are what cause them problems in various area including academic and social functioning, sleep, and aggression (Travell, & Visser, 2006). There is a need to better understand the association between ADHD symptoms and college student substance use, negative consequences, and overall functioning and adjustment to college.

Impulsivity. In addition to severity of ADHD symptoms, impulsivity itself is often considered an ADHD risk factor that can predict substance use. There are many facets of impulsivity with a variety of measures used. The UPPS-P is a 59-item inventory designed to measure five personality traits linked to impulsive behavior: Negative Urgency, (lack of) Premeditation, (lack of) Perseverance, Sensation Seeking, and Positive Urgency (Lynam, Smith, Whiteside, & Cyders, 2006). Each item on the UPPS-P is rated on a 4-point Likert scale from “Strongly Agree to Strongly Disagree”. Average scores are calculated for each scale. This measure is widely used among college students. There is research indicating relationships between impulsivity and substance use as well as studies of impulsivity helping to explain the risk for substance among individuals with ADHD. For instance, it has been demonstrated that impulsivity (measured with the UPPS-P) generally has a direct link to alcohol use among adults, with drinking motives serving as a mediator between this relationship (Adams, Kaiser, Lynam, Charnigo, & Milich, 2012). Moreover, Blanchard and colleagues, using a sample of 778 college students, found that specific impulsive dispositions on the UPPS-P helped differentiate between college student substance users and non-users (Blanchard, Stevens, Littlefield, Talley, & Brown, 2017), suggesting that specific traits of impulsivity might be used to predict substance use and associated consequences among college students.

There are also laboratory studies that show this relationship. For example, Kollins (2003), studied a sample of 47 college students to assess the role of impulsivity in substance use with a delayed discounting impulsivity task. Findings showed that the discounting values were significantly associated with age of first alcohol use, age of first smoking, age of first marijuana use, number of times “passed out” from alcohol use, and total number of illicit drugs used (Kollins, 2003). These results demonstrate the importance of impulsivity in initiation of alcohol and other drug use, which may lead to heavier use in college.

Among emerging adults (i.e., 18 - 24-yrs-old), Lee and colleagues found that negative urgency (from the UPPS-P) predicted increased risk for these individuals to be classified as daily smokers (Lee, Peters, Adams, Milich, & Lynam, 2015). The lack of premeditation factor predicted increased risk to be in the non-daily smoking group, showing that different facets of impulsivity may be related to substance use behavior among emerging adults. Further, facets of the UPPS-P have been related to alcohol outcomes among young adults. In one study, the sensation seeking facet of the UPPS-P was the best predictor of alcohol use, with urgency being the best predictor of alcohol-related consequences among 202 young adults (*M* age = 19.48; Female = 87%; Caucasian = 78%) (Kiselica, Echevarria, & Borders, 2015). In another study, findings indicated that the negative urgency facet of the UPPS-P was associated with the following alcohol-related negative consequences: social/interpersonal, self-perception, risky behaviors, and blackout drinking; while the positive urgency factor was associated with academic/occupational and physiological dependence problems (McCarty, Morris, Hatz, & McCarthy, 2017).

Moreover, impulsivity is a core symptom of ADHD and there is research linking ADHD and impulsivity among young and middle-aged adults. For example, Lopez and colleagues, in a longitudinal study, assessed 219 adult individuals, age 18 – 57-years-old, with and without a childhood ADHD diagnosis after being matched on age, gender, and four dimensions of impulsivity (urgency, lack of premeditation, lack of perseverance, and sensation seeking) using the UPPS-P Impulsive Behavior Scale

(Lopez, Dauvilliers, Jaussent, Billieux, & Bayard, 2015). Individuals with ADHD had higher urgency, lower premeditation, and lower perseverance compared to the control group. In addition, those that had the combined inattention/hyperactivity type of ADHD had higher urgency scores and reported higher levels of substance use. This study not only demonstrates the link between ADHD and impulsivity symptoms; it suggests that among ADHD individuals those with a combined presentation type experience higher levels of a particular facet of impulsivity (urgency). However, it should be noted that this study involved middle age adults with ADHD and it may not necessarily generalize to emerging adults. Emerging adults and college students with ADHD may have less compensatory strategies and may exhibit higher levels of overall ADHD symptoms as well as impulsivity traits due to their age. This could influence the relationship of ADHD and impulsivity during this developmental period, especially when considering substance use as another associated factor.

In terms of the relationship of impulsivity and ADHD among college students, there have been some limited findings. For example, Barnhart and Buelow (2017), assessed impulsivity among 175 college students (*M* age = 19.0; Female = 54.3%; Caucasian = 78.9%, with (N = 28) and without (N = 147) self-reported ADHD. Interestingly, attentional impulsivity on the BIS (Behavioral Inhibition) was able to distinguish between individuals with and without a self-reported diagnosis of ADHD, with those having reported ADHD experiencing higher levels of impulsivity.

Clearly, there is a link between ADHD and impulsivity as well as between impulsivity and substance use. However, there are very few studies assessing associations between impulsivity and substance use among ADHD college students.

Further, there is also limited research examining the role of substance use on impulsivity and psychosocial/academic consequences among college students with ADHD. Thus, research should examine the relationship of impulsivity traits to substance use among ADHD college students and extend this research to specifically analyzing the possible moderating effect of substance use on impulsivity's relationship to negative psychosocial and academic outcomes. Further, the majority of studies that examine ADHD symptom severity and impulsivity use self-report measures versus objective behavioral symptom assessment. The difference between these two types of assessment is discussed in detail in the next section.

Self-Report Symptoms vs. Objective Behavioral Assessment. When assessing ADHD symptoms among college students there are several issues that must be considered. For instance, it is important to consider that there are various ways to assess ADHD symptoms among college students. The most common include structured clinical interviews, self-report measures and objective behavioral symptom assessment. However, there are distinct differences between these types of measurement. Structured clinical interviews and self-report measures are considered tools used to ask the respondent about their symptoms of ADHD versus an objective behavioral symptom assessment, which directly observes symptoms of attentional problems and ADHD through laboratory behavioral tasks.

Structured clinical interviews involve a clinician who assess for various symptoms of ADHD and can include using a structured format such as the Structured Clinical Interview for DSM-5, Clinical Version (SCID-5-CV; First, Williams, Karg, & Spitzer, 2015). Structured clinical interviews are used to focus on developmental features, history, current symptoms and impact, and medical issues and comorbidities of ADHD and other disorders.

Self-report measures typically involve a respondent filling out a questionnaire about their past and current symptoms of ADHD. There are a number of reliable and valid measures in this format including the Barkley Adult ADHD Rating Scale, fourth edition, self-report (BARRS-IV; Barkley, 2011) and the Adult ADHD Self-Report Scale (ASRS; Schweitzer, Cummins, & Kant, 2001). Research has demonstrated that self-report measures can be used to aid in the diagnosis of ADHD and many are considered reliable and valid measures (Taylor, Deb, & Unwin, 2011). However, there may be problems using only self-report measures in diagnosing ADHD. Sibley and colleagues note that retrospective reporting of ADHD symptoms in childhood by young adults and college students is important but must be interpreted with caution (Sibley, Pelham, Molina, Gnagy, Waxmonsky, Waschbusch, & ... Kuriyan, 2012). If possible, parents of college students and young adults should be contacted to collaborate symptoms of ADHD and their presence in childhood.

It has been estimated that up to 22% of college students seeking evaluation for ADHD may exaggerate deficits (Marshall, Schroeder, O'Brien, Fischer, Ries, Blesi & Barker, 2010), making it extremely important to utilize other sources of information such as parent and teacher reports. The BARRS-IV (previously mentioned) also contains an "other-report" form for childhood and current ADHD symptoms that can be filled out by a parent or teacher. This can be particularly useful with college students who might exaggerate symptoms.

In measuring impulsivity, there may also be differences between asking about

ADHD symptoms from the DSM-5 criteria and separate measures of the impulsivity construct as represented by the UPPS-P. Current research would indicate that ADHD diagnosed individuals may score higher on some aspects of the UPPS-P (Lopez, Dauvilliers, Jaussent, Billieux, & Bayard, 2015) but which aspects are most related to ADHD in young adults and their relationship to substance use is unknown.

Finally, objective behavioral symptom assessment can be used to capture symptoms of ADHD using laboratory testing. Some of the most common behavioral measures are Continuous Performance Tasks (CPTs), which are task-oriented assessment of attention-related problems, specifically visual and/or auditory attention (Osvold, Mirsky, Sarason, Bransom, Beck, 1956). These measures would include the Connors Continuous Performance Task, 3rd edition (CPT 3; Conners, & Sitarenios, 2011) as well as the Test of Variables of Attention (T.O.V.A.; Greenberg, Kindschi, & Corman, 1996).

The T.O.V.A. is a computer task often used to measure specific aspects of attention commonly affected in individuals with ADHD; it evaluates attention by examining a respondent's response time and accuracy in responding to a series of visually (or auditorily) presented target and non-target stimuli. The test-taker responds to the target stimulus by pressing a micro-switch. An individual's performance is compared to age norms as well as the performance of individuals with ADHD. More specifically, the T.O.V.A. provides standard scores for response times, response time variability, commission or impulsive errors, and omissions. Purported advantages of using this CPT instrument are that it increases diagnostic accuracy, facilitates case management and planning, and can be used to evaluate medication dose.

Much of the research on ADHD among college students uses self-reports and structured clinical interviews. There is some research attempting to use laboratory measures such as behavioral measures of impulsivity or CPTs; however, there is still limited data at this time. Further, the majority of studies that use these tasks are assessing differences among ADHD and non-ADHD samples and have failed to look at prediction of substance use or specific difficulties (i.e., psychosocial and academic functioning) using these tasks. Finally, although the T.O.V.A has been used to help identify ADHD among substance abuse patients, there are no studies to date that have used the T.O.V.A. to predict substance use among ADHD college students. Structured clinical interviews are useful for diagnostic purposes and self-report measures provide evidence of perceived severity of symptoms, but it would be desirable to also include direct behavioral measurement of these symptoms as well.

Executive Functioning Deficits. Executive functioning is a broad term, which includes a number of controlled processes (associated with the frontal cortex of the brain) that involve attention, resource allocation and self-management in order to achieve a goal. It includes the ability to engage in goal driven activities involving the following components: planning, organizing, problem solving, decision-making, initiating and self-regulating behavior and accompanying motivation (Blume & Marlatt, 2009). Deficits in executive functioning can lead to difficulties in various areas of life functioning.

Barkley and colleagues have argued that ADHD among adults involves significant deficits in executive functioning (Barkley & Murphy, 2011). He proposed that ADHD is linked to deficits in behavioral inhibition, working memory, self-regulation of affect-motivation-arousal, internalization of speech, and reconstitution (Barkley, 1997), all of which are types of executive functioning. Further, a commonly used tool to measure executive functioning deficits is the Barkley Deficits in Executive Functioning Scale (B-DEFS; Barkley, 2011). The B-DEFS involves self-report of executive functioning difficulties associated with ADHD and covers a number of domains including self-organization, self-restraint, self-motivation, self-regulation of emotion, and self-management to time.

There are also neuropsychological performance subtests that have been used to measure executive functioning deficits. One such measure, the Delis–Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001), has been selected for some of its individual subtests to help assess for ADHD. For example, in a comparison study of purely ADHD young adults (N = 26; *M* age = 24.08; Female = 23%; Caucasian = 88.46%) and purely reading disordered young adults (N = 38; *M* age = 20.29; Female = 50%; Caucasian = 68.42%), findings suggested that these disorders can be identified separately using the Trail Making subtest of the D-KEFS (Stern, & Morris, 2013). Specifically, the Trail Making executive function test was able to significantly predict those with ADHD. However, other subtests of the D-KEFS were not significant; overall, the D-KEFS demonstrated strong specificity, but weak sensitivity, suggesting that using only the D-KEFS (Trail Making) may not be sufficient in examining executive functioning among ADHD young adults. Other studies have demonstrated the efficacy of using the Stroop task (color-word interference task that measures executive functioning) to identify ADHD symptoms among children (Kóbor, Takács, Bryce, Szűcs, Honbolygó, Nagy, & Csépe, 2015). Interestingly, one study found that Stroop interference tends to decrease with age, while reverse-Stroop interference tends to increase with age (Ikeda, Okuzumi, & Kokubun, 2013). Further, their findings showed that ADHD symptoms (measured on the ADHD Rating Scale – IV) were related to the Stroop interference, but not the reverse-Stroop interference scores, suggesting that it may be more difficult to identify ADHD symptoms among adults using this measure of executive functioning.

Barkley (2011) has argued these neuropsychological tests do not consistently identify those with ADHD and have low ecological validity. Instead he suggests that more molar measures of executive functioning in daily life better assess executive functioning difficulties in adults with ADHD. Barkley and Murphy (2011) conducted a study to assess deficits in daily life activities in adults with ADHD. The sample included three groups: Clinically diagnosed ADHD adults (N = 146; *M* age = 32.4), clinical control group (N = 97; *M* age = 37.8), and a community control group (N = 109; *M* age = 36.4). Findings showed 5 distinct factors (domains): self-organization, self-restraint, self-motivation, self-regulation of emotion, and self-management to time (subscales of the B-DEFS). Both the ADHD and clinical control exhibited more deficits in daily life activities than the community control group. In addition, they argued that ratings of executive functioning in daily life accounted for in the B-DEFS are more strongly associated impairments in occupational functioning and general impairment in major life activities as well as ADHD symptoms than executive functioning tests.

In addition, Kamradt and colleagues assessed executive functioning and ADHD using tasks versus ratings on the B-DEFS using a sample of 273 adults (ages = 18 – 38 years; *M* age = 22.6 years; Male = 55.3%), with 62.2% of the sample diagnosed with ADHD (Kamradt, Ullsperger, & Nikolas, 2014). Findings indicated that tasks of arousal/activation and response inhibition predicted ADHD symptom dimensions and related impairments. However, executive functioning ratings of time management predicted increased inattention and ratings of restraint predicted increased hyperactivity/impulsivity symptoms, over and above the tasks. These ratings also accounted for a significant amount of the variance in executive function deficits, suggesting that self-rating tools such as the B-DEFS can distinguish ADHD from non-ADHD adults, as Barkely has previously argued.

There is already a substantial literature that indicates deficits in executive functioning are linked to substance use (Blume & Marlatt, 2009). This issue is complex in that research indicates that substance use itself can lead to deficits in attention and executive functioning, along with poorer performance on memory and visual spatial tasks, and is also associated with impulsivity, working memory deficits, and decision-making difficulties (Vik, Cellucci, Jarchow, & Hedt, 2004; Yücel, Lubman, Solowij, & Brewer, 2007). Similar to Barkley's argument to use more molar measures of executive functioning when assessing ADHD individuals; Hagen and colleagues report a study comparing inventory and performance-based measurement among patients with a SUD (N = 126; *M* age = 28.5; Male = 67.5%) and without a SUD (N = 32; *M* age = 33.7; Male = 40.6%) (Hagen, Erga, Hagen, Nesvåg, McKay, Lundervold, & Walderhaug, 2016). Findings suggested that only a select few of the neuropsychological tests (i.e., Stroop and Trail making) administered helped to differentiate SUD patients from controls. However, all scales on the BRIEF-A (self-report inventory) helped to differentiate SUD patients from controls. The authors argue that the BRIEF-A was a more sensitive measure of executive functioning difficulties in substance use; thus, inventories such as the BRIEF-A or B-DEFS might be better used to assess executive functioning deficits among ADHD, substance using individuals.

A recent pilot study assessed ADHD individuals (N = 13) with SUDs in treatment. ADHD was measured using the WURS-25 and ASRS as screening instruments and the CIDI to confirm diagnosis with a diagnostic interview. Substance abuse patients with comorbid ADHD reported greater deficits in executive functioning (on the B-DEFS) than those with substance dependence only (Stanton, Cellucci, Mochrie, Lutes, 2015). It is likely there is an interactive influence between ADHD related difficulties in executive functioning and those deficits associated with SUD.

The role of executive functioning in association with substance use and ADHD has been somewhat limited in the existing literature. However, one study attempted to address this issue by examining ADHD and marijuana use in relation to neuropsychological testing among a sample of emerging adults (Tamm, Epstein, Lisdahl, Molina, Tapert, Hinshaw, & ... Swanson, 2013). The study contained four separate groups based on ADHD diagnostic status and marijuana use status: 1. ADHD non-user group: 45; Age: *M* = 24.6; Male: 73.3%; Caucasian: 60%. 2. ADHD user group: 42; Age: *M* = 24.4; Male: 92.9%; Caucasian: 57.1%. 3. Control non-user group: 21; Age: *M* = 23.4; Male: 66.7%; Caucasian: 57.1%. 4. Control user group: 20; Age: *M* = 23.7; Male: 85%; Caucasian: 70%. Participants were given a wide array of neuropsychological tests including the Hopkins Verbal Learning Task (HVLT), Iowa Gambling Task (IGT Net), Trail Making Test (TMT), HVLT Recall, Go/NoGo (GNG), Delis-Kaplan Color-Word Interference Task (D-KEFS), and Paced Auditory Serial Addition Test (PASAT). Findings revealed that the ADHD groups performed significantly worse on all of the neuropsychological testing except HVLT (delayed recall), TMT, and the GNG task. Further, cannabis users performed more poorly on the IGT Net score compared to non-users; however, there were no other significant main effects for cannabis use and neuropsychological tests (Tamm et al., 2013). Interestingly, there were no interaction effects, suggesting that ADHD users do not experience more difficulties in executive functioning beyond just marijuana users or those just with ADHD. However, this needs to be addressed in college student samples, looking at a variety of different drugs, including alcohol use. By examining the relationship of ADHD to executive functioning, while simultaneously assessing the relationship of executive functioning difficulties to substance use and associated consequences, the present study adds to the existing literature.

Academic and Psychosocial Functioning of College Students with ADHD

Academic Functioning. College students with ADHD are at a higher risk of developing problems in academic functioning compared to students without ADHD. There are a variety of studies demonstrating significantly lower GPAs among college students with ADHD than those without ADHD (Blase et al., 2009; Frazier et al., 2007; Weyandt & DuPaul, 2013a), although differences in GPA do not always reach significance levels (Mochrie, et al., 2016). Other research points to specific negative outcomes such as poor performance on class assignments, higher rates of academic probation, higher rates of dropping classes, and lower rates of graduation among ADHD compared to non-ADHD college students (Frazier et al., 2007; Turnock, Rosen, & Kaminski, 1998; Weyandt et al., 2013a; Wolf, 2001). Similarly, findings have shown that college students with ADHD have significantly lower mean grade point averages, are more likely to be on academic probation, and report significantly more academic problems compared to non-ADHD peers (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999).

Additionally, research has found deficits in learning and study strategies among this population. For example, a number of studies have found that ADHD college students present with difficulties in organization, time management, concentration, motivation, information processing, and study strategies and skills (Advokat, Lane, & Luo, 2011; Norwalk, Norvilitis, & MacLean, 2009; Prevatt, Proctor, Baker, Garrett, & Yelland, 2011; Turnock, Rosen, & Kaminski, 1998; Weyandt et al., 2013a; Weyandt et al., 2017). In particular, time management and estimation of the amount of time it takes to complete tasks seem to be two of the main difficulties experienced in this population (Prevatt et al., 2011). Such difficulties can be understood in terms of executive functioning difficulties and it is easy to understand how they would interfere with an individual's academic success. It is likely that a combination of having symptoms of ADHD and associated deficits in areas such as time management and study strategies culminate to make it more difficult for ADHD college students to succeed academically than their non-ADHD peers.

Psychosocial Functioning. Academic functioning is not the only area of concern for ADHD college students. College students with ADHD may be at a particularly high risk for developing difficulties in psychosocial functioning as well. Some research points to higher prevalence of deficits in social, emotional, and adaptive abilities among this group that may extend into adulthood. For example, Yang and colleagues examined the impact of childhood ADHD symptoms on quality of life among

1,382 young adult men (age range: 19 to 30; *M* age = 23.59) (Yang et al., 2013). Data was collected from self-report surveys' and included measures of ADHD symptoms (i.e., ASRS; SNAP-IV), quality of life in various domains (i.e., AAQoL), and anxiety/depression (i.e., ASRI-4). Findings suggested that individuals with childhood symptoms of ADHD were at a greater risk for impairment and lower quality of life as young adults. Further, current ADHD symptoms predicted greater impact in functioning (i.e., life productivity; psychological health; relationships; life outlook), specifically, showing decreased overall quality of life. Finally, results showed that both anxiety and depression were mediators of the link between childhood ADHD symptoms and quality of life. Future research needs to assess other predictors of psychosocial functioning deficits and include anxiety and depression as outcome variables.

In addition, research has assessed psychosocial functioning in terms of test anxiety and self-esteem among college students. Students with ADHD are at a greater risk for developing these problems than those without ADHD (Dan & Raz, 2015). Further, there is evidence that ADHD individuals may experience associated features of the disorder which can impact psychosocial functioning, such as low frustration tolerance, irritability, or mood labiality (APA, 2013). Studies have shown a wide variety of comorbid disorders among ADHD college students including anxiety, depression, and substance use (Dan & Raz, 2015; APA, 2013, Yang et al., 2013), which can all lead to negative outcomes in terms of psychosocial functioning. Moreover, by the time these individuals enter college they are at an increased likelihood of suicide attempts, especially when experiencing comorbid mood, conduct, or substance use disorders (Agosti, Chen, & Levin, 2011). Safren and colleagues examined ADHD and its relationship to life impairments among 105 adults with diagnosed ADHD who were all being treated with prescription medication (age = 18 – 65; *M* age = 41.96; Males = 52%; Caucasian = 84.80%) (Safren, Sprich, Cooper-Vince, Knouse, & Lerner, 2010). Findings revealed that adult individuals with ADHD are uniquely at risk for work and interpersonal impairment. Further, overall life satisfaction was significantly associated with depression and anxiety symptoms in this sample, suggesting that adult individuals with ADHD experience a variety of negative psychosocial outcomes, regardless of medication treatment. Unfortunately, there is considerable evidence for a variety of negative psychosocial outcomes among adults with ADHD, including those in college. However, the role substance use plays in this relationship is murky.

The Unknown Contribution of Alcohol and Other Drug Use. It has been well documented that substance use is associated with academic and psychosocial problems among college students (Egan et al., 2013; Knee & Neighbors, 2002). In particular, substance use among college students has been associated with lower academic functioning. For example, substance use is associated with lower overall GPA and diminished academic performance in this population (Egan et al., 2013). Further, heavy alcohol consumption (e.g., binge drinking) among college students has been shown to lead to poorer academic performance and social-interpersonal consequences (Knee & Neighbors, 2002; Wechsler et al., 2002). Specifically, a study by Singleton and Wolfson (2009), investigated the relationship between alcohol use, sleep, and academic functioning among 236 college students (Age = 18-22yrs, mean age not reported; Female = 52%; Caucasian = 89%) at a liberal arts college. Findings indicated that alcohol consumption significantly predicted four sleep patterns: The duration of sleep, the timing of sleep, the difference between weekday and weekend nighttime sleep hours (oversleep), and the difference between weekday and weekend bedtimes (bedtime delay), with students who engaged in more consumption experiencing more problems in these domains. Further, alcohol consumption, sleep duration, and daytime sleepiness predicted GPA, with alcohol consumption having a mediation effect on sleepiness and GPA. It is likely the combination of impaired sleep and alcohol use led to decreased academic performance among this sample of college students. In addition, some literature has looked at this relationship in the context of peer substance use. For example, Boot and colleagues found a negative relationship between misperception of peer substance use (i.e., perceived high base rates of heavy alcohol, marijuana, and tobacco use) and health/academic functioning among 6,403 college students in Europe (Boot, Dahlin, Lintonen, Stock, Van Hal, Rasmussen, & McAlaney, 2013).

In terms of marijuana use, research has demonstrated its negative effect on high school grades, high school graduation rates, and the likelihood of entering college (Arria, Caldeira, Bugbee, Vincent, & O'Grady, 2015). Further, marijuana use among college students can create memory issues, which may affect sustaining attention during academic pursuits and increase skipping classes. In addition, there has been some research examining the role of craving and marijuana use in academic functioning among college students. For example, in a sample of 57, 18-29-year-old college students the association between craving, marijuana use, and academic functioning was examined using Ecological Momentary Assessment (EMA) through text messaging (Phillips, Phillips, Lalonde, & Tormohlen, 2015). Results showed that momentary craving positively predicted greater marijuana use. Further, as cravings for marijuana increased, the number of minutes spent studying decreased. Finally, average minutes spent smoking marijuana was negatively related to GPA.

There has also been research linking substance use to negative psychosocial functioning among college students. For example, O'Conner (2016) sampled 103 college students to assess substance use and personality characteristics on the MMPI-2. Results showed that problematic substance users (i.e., abuse/dependence levels of substance use) had significantly higher elevations on the Mf (5) scale and PD scale (4) than non-problem users, indicating that problematic substance use was related to feelings of guilt and antisocial characteristics, respectively. In addition, problem users were generally more depressed, anxious, tense, and guilt prone. Moreover, among individuals with a history of opiate use, there were consistent elevations on scale Ps (7), indicating higher levels of anxiety compared to those without a history of opiate use.

Other research demonstrates the link between alcohol use and internalizing symptoms among college students (Homman, Edwards, Cho, Dick, & Kendler, 2017). Findings suggest that college students who engage in alcohol use may be at a higher risk for developing internalizing problems such as depression and anxiety than those who do not engage in this substance use. In addition, research has demonstrated a strong link between health anxiety and non-prescription drug use among young adults (Jeffers, Benotsch, Green, Bannerman, Darby, Kelley, & Martin, 2015). It is likely that some college students are using alcohol and other drugs to self-medicate psychiatric symptoms, while others may use for various reasons and could find themselves experiencing more psychosocial problems than non-using peers. College students who engage in binge drinking are also at a higher risk for negative psychosocial outcomes (Yi, Ngin, Peltzer, & Pengpid, 2017). For instance, there is a clear association between higher levels of binge drinking and depression among male college students, and depression and lower quality of life among females (Yi et al., 2017).

Undoubtedly, there are various psychosocial deficits that college students can experience in relation to alcohol and other drug use. Further, ADHD among college students has been linked to a variety of problematic psychosocial outcomes. Substance use among college students is also associated with poor academic functioning. Interestingly, there is less research on other illicit drug use besides marijuana use, likely due to the low number of college students who are actually engaging in other illicit drug use. However, there is research that links both ADHD and substance use to lower academic and psychosocial functioning outcomes. Surprisingly, there are fewer studies that attempt to address how some of the specific factors associated with ADHD might predict academic and psychosocial functioning among college students. Moreover, the role that substance use might play in understanding the difficulties in these domains among ADHD college students experience is even less clear.

Current Gaps in the Literature on ADHD and Substance Abuse in College Students

There is now considerable evidence indicating that individuals with a diagnosis of ADHD have a greater risk for developing substance use problems. This may be particularly true among beginning college students with ADHD. Several predictive relationships to substance use (e.g., impulsivity, peer influence, history of substance use, etc.) have been previously found in the general population literature comparing ADHD groups to non-ADHD groups, but there are limitations in the existing literature.

First, the majority of existing studies with emerging adults and college students have used between-group designs. This method does not account for differences among ADHD individuals that may predict substance use and associated consequences. Further, most studies have relied on self-report of diagnosis and do not include objective behavioral tasks to assess symptoms of inattention or impulsivity. The use of objective behavioral measures to assess ADHD symptom impairment would add to the existing literature.

In regard to substance use, there are clear links between ADHD and risk for alcohol and other drug use. However, a limited range of predictors have been studied without consideration of the general literature on predictors of substance use among college students versus those factors specifically associated with ADHD which might increase risk, and how they might interact. For example, although there is a clear link between peer influence and substance use among college students, there is less known about the role of peer influence among ADHD college students, and its role in college students' experience of negative consequences. In addition, differences in positive expectancies for substance use among ADHD college students have not been widely studied to date. Interestingly, the misuse of stimulant medication is often studied separately although it has been clearly linked to both students reporting ADHD symptoms and other alcohol and drug use.

Further, associations between ADHD and psychosocial/academic functioning have also been mostly researched in between-group designs with less attention to individual variability among those with ADHD. There is limited research examining what aspects of ADHD (e.g., inattention, impulsivity, and executive functioning deficits) are most related to difficulties in academic or psychosocial functioning generally. Moreover, it is known that substance abuse among college students is related to similar difficulties (e.g., poorer academic performance, depression, etc.) and yet negative consequences due to substance abuse are not typically examined. Finally, there is little evidence assessing the role that substance use might play as a moderator in the relationship between ADHD symptom severity and psychosocial and academic functioning outcomes.

Purpose of Present Study

The purpose of the present study was to evaluate the relationship of general and ADHD specific predictors of substance use and problems in this specialized at-risk population and any associated negative outcomes. In addition, the present study assessed the role of substance use as a possible moderating influence on the known difficulties in academic adjustment and psychosocial functioning commonly reported among ADHD students. There are several studies to date that have assessed various aspects of these research questions; however, the present study went beyond previous research addressing predictors of substance use together and its broader impact; mainly, the moderating role of substance use on ADHD specific factors' association with psychosocial/academic functioning. Individuals with ADHD are known to have more difficulties with psychosocial/academic functioning, and it is thought these difficulties might be explained by ADHD specific predictors. However, there is also research to show that substance use itself is a risk factor in developing problems in psychosocial/academic functioning. Thus, an interaction effect might be expected when examining substance use as a moderator of ADHD specific factors and psychosocial/ academic functioning due to a possible synergistic effect of this combination of comorbid problems.

Thus, the aim of the present study was to replicate and add to existing findings on the topic of substance abuse risk within a sample of ADHD college students. Several methods were employed to confirm the validity of self-reported ADHD diagnosis in childhood and current symptom status. In addition, this study significantly adds to existing literature by using an objective behavioral measure of ADHD symptom impairment (T.O.V.A.) and distinguishes between general substance and ADHD specific risk factors. The study included assessment of both substance use and associated negative consequences and the general psychosocial and academic adjustment of these students at a local university. The impact of both substance use and ADHD symptomology on college adjustment was examined separately, and the possible moderating influence of the former explored. Finally, the present study looked at various predictors of substance use within a single model, which expands on previous literature that generally has examined only single relationships.

Study Aims and Hypotheses

Aim 1. Describe the substance use patterns and associated substance use negative consequences within this sample of ADHD college students as well as examine correlations between substance use variables.

- Describe substance use variables within the study sample using descriptive statistics with sample means, standard deviations, and percentages (i.e., alcohol history of use and quantity/frequency of use in the past three months, binge drinking in the past three months, marijuana use history and quantity/frequency of use in the past three months, other illicit drug use history and quantity/frequency of use in the past three months, non-prescription use of stimulant medication history and quantity/frequency of use in the past year , and lifetime number of drugs used).

- Describe substance use negative consequences within the sample (i.e., negative consequences of alcohol and other drug use in the past three months) using descriptive statistics with sample means, standard deviations, and percentages.

Hypothesis 1. It was hypothesized that heavier substance use (in terms of quantity/frequency) would be correlated with substance use negative consequences.

Hypothesis 2. It was hypothesized that higher quantity and frequency of substance use within the past three months would be associated with non-prescription use of ADHD stimulant medication.

Aim 2. Assess the relationship of general substance use predictors and ADHD specific predictors to substance use patterns and substance use negative consequences among an ADHD college student sample.

Hypothesis 1. It was hypothesized that higher levels of general substance use risk factors would predict higher levels of substance use and substance use negative consequences over the past three months.

- Higher levels of alcohol and other drug use history would predict higher levels of current substance use and increased substance use negative consequences.

- Greater history of conduct disorder symptoms would predict higher levels of current substance use and increased substance use negative consequences.
- Higher levels of peer influence on alcohol and other drug use would predict higher levels of current substance use and increased substance use negative consequences.
- Increased positive alcohol and other drug expectancies would predict higher levels of current alcohol use and increased alcohol use negative consequences.
- Higher levels of sensation seeking would predict higher levels of current substance use and increased substance use negative consequences.

Hypothesis 2. It was hypothesized that higher levels of specific ADHD factors would predict higher levels of substance use and substance use negative consequences over the past three months.

- Greater severity of self-reported ADHD symptoms would predict higher levels of current substance use and increased substance use negative consequences.
- Performance scores on the T.O.V.A (i.e., longer response times, greater response time variability, more commission errors, and a higher number of omissions) would predict higher levels of current substance use and increased substance use negative consequences.
- Higher levels of self-reported impulsivity and emotional dysregulation (i.e., higher levels of positive and negative urgency on S-UPPS) would predict higher levels of current substance use and increased substance use negative consequences.
- Greater executive functioning deficits would predict higher levels of current substance use and increased substance use negative consequences.

Hypothesis 3. An exploratory analysis using both general and ADHD specific predictors within a single model was conducted. It was hypothesized that there would be significant ADHD specific predictors which might account for additional variance in substance use and associated consequences above that of general predictors.

Hypothesis 4. It was hypothesized that ADHD severity of symptoms (i.e. ASRS) would interact with current substance use variables (i.e., current alcohol consumption, binge drinking status, current marijuana use, classification as a regular marijuana user, and Other Illicit drug use) to increase substance use consequences on the SIP-D.

Aim 3. Describe the psychosocial and academic functioning of ADHD college students within the study sample as well as the relationship of ADHD specific predictors to psychosocial/academic difficulties.

- Describe the psychosocial functioning of the sample (i.e., depression, anxiety, and social adjustment to college) using descriptive statistics with sample means, standard deviations, and percentages.
- Describe the academic functioning of the sample (i.e., academic adjustment and GPA) using descriptive statistics with sample means, standard deviations, and percentages.

Hypothesis 1. It was hypothesized that the ADHD specific predictors would predict higher levels of psychosocial difficulties.

Hypothesis 2. It was hypothesized that the ADHD specific predictors would predict higher levels of academic difficulties.

Aim 4. Assess the impact of substance use on psychosocial outcomes and academic functioning within a sample of all ADHD college students.

Hypothesis 1. It was hypothesized that individuals with higher levels of current alcohol use (quantity and frequency) would report higher levels of psychosocial and academic problems compared to those that do not drink and those using less alcohol.

- Individuals who reported higher levels of alcohol use in the last three months would report higher levels of psychosocial problems (i.e., depression, anxiety, and social adjustment to college).
- Individuals who reported higher levels of alcohol use in the last three months would report higher levels of academic problems (i.e., high academic adjustment difficulties and lower overall GPA).

Hypothesis 2. It was hypothesized that individuals with higher levels of current drug use (quantity and frequency) would report higher levels of psychosocial and academic problems compared to those that do not use drugs.

- Individuals who reported higher levels of drug use in the last three months would report higher levels of psychosocial problems (i.e., depression, anxiety, and social adjustment to college).
- Individuals who reported higher levels of drug use in the last three months would report higher levels of academic problems (i.e., high academic adjustment difficulties and lower overall GPA).

Hypothesis 3. Substance use would be a significant moderator between ADHD specific predictors and psychosocial and academic problems in this population.

- Individuals who have higher levels of ADHD specific predictors (i.e., self-reported current ADHD symptoms, T.O.V.A. outcomes, Impulsivity, and executive functioning deficits) in combination with higher levels of substance use in the last three months would report higher levels of psychosocial problems (i.e., depression, anxiety, and social adjustment to college). This relationship would be moderated by current substance use, with a hypothesized interaction effect of those with higher levels of ADHD specific predictors and higher levels of current substance use experiencing higher levels of psychosocial problems than others in the sample.

- Individuals who have higher levels of ADHD specific predictors (i.e., self-reported current ADHD symptoms, T.O.V.A. outcomes, Impulsivity, and executive functioning deficits) in combination with higher levels of substance use in the last three months would report higher levels of academic problems (i.e., high academic adjustment difficulties and lower overall GPA. This relationship would be moderated by current substance use, with a hypothesized interaction effect of those with higher levels of ADHD specific predictors and higher levels of current substance use experiencing higher levels of academic problems than others in the sample.

CHAPTER III: METHODS

Participants

Participants included 66 (Males = 40; Females = 26; 81.8% Caucasian) local university students, ages 18 to 26, who reported a prior diagnosis of ADHD. The majority of the sample participants were Freshmen (62.1%) and Sophomore (27.3%) students, single (56.9%), who reported living in a dorm (71.2%). On average, participants reported their current college GPA as 2.76 (SD = .83). A full description of the sample demographics can be found in *Table 2* below.

Table 2. Demographics

Demographic Variables	N (% of Sample)
Age	Range = 18 to 26 years old *M* = 19.17; SD = 1.55
Sex	Males = 40 (60.6%) Females = 26 (39.4%)
Ethnicity	Caucasian = 54 (81.8%) Multiracial = 5 (7.6%) African American = 3 (4.5%) Asian or Pacific Islander = 2 (3.0%) Hispanic = 2 (3.0%)
Year in College	Freshman = 41 (62.1%) Sophomores = 18 (27.3%) Junior = 7 (10.6%)
College GPA	Range = 0.18 to 4.0 *M* = 2.76; SD = .83
Highschool GPA	Range = 1.5 to 4.0 *M* = 3.39; SD = .47

Fraternity/Sorority Affiliation	Yes = 13 (19.7%) No = 53 (80.3%)
Current Living Situation	Dorm = 47 (71.2%) Apartment = 18 (27.3%) Living with Parents = 1 (1.5%)
Relationship Status	Single = 37 (56.9%) Exclusive Relationship = 19 (29.2%) Dating = 8 (11.3%) Married = 1 (1.5%)

Procedure

All participants were recruited after obtaining approval from the Institutional Review Board (IRB) for the present study. Participants were recruited from multiple sources including the psychology undergraduate research system (SONA) and through more targeted recruitment. After obtaining the necessary permissions, flyers announcing the study were posted in Department for Disability Support Services at East Carolina University (ECU), the ECU Counseling Center, and around the campus as allowed. In addition, the primary investigator consulted with directors of these facilities to increase referrals to participate in the study. The flyers asked individuals who had been diagnosed with ADHD to email the Principle Investigator to schedule a study participation time (estimated to last up to two hours) to sign the informed consent and participate in the study investigating ADHD college student substance use risk and overall functioning. In addition, the ECU Counseling Center distributed flyers to individuals who were seeing the psychiatrist for ADHD concerns and medication. Within the final sample, 48 participants (72.7%) were recruited through the SONA system, 14 (21.2%) through a flyer, 8 (12.1%) through a professor announcement in class, 2 (3.0%) through disability services, and 1 (1.5%) through an “other” source.

The informed consent for this study explained that participants were asked to complete on site an online anonymous survey and a laboratory measure of attention, and a diagnostic interview administered by a member of the research team. All of these measures were conducted in a laboratory setting in the psychology department of East Carolina University. Further, there was a box to check on the informed consent, indicating if the participant agreed to sign a release of information for a member of the research team to contact the participant's parent or legal guardian later to confirm ADD/ADHD diagnosis and obtain their report on childhood symptoms. The participant could elect to not sign the parental release.

Sixty-two participants (approximately 94%) signed a release of information for the research team to contact a parent or legal guardian to confirm their prior ADHD diagnosis. Three participants reported they grew up in a foster care system and did not have a parent to contact and one participant reported they did "not get along" with their parents and preferred not to sign a release of information. Of the 62 parents who were contacted, 60 (90.91% of the total sample) confirmed a childhood diagnosis of ADHD for the participants. Two of the parents never responded to the messages left to contact the research team.

After the participants signed these forms, they were placed into a locked file cabinet. Next, a researcher collected participant data, only using a study ID so that there was no link between the participant's name and their data to ensure anonymity. The data collected from phone interviews was only used to report descriptors for the entire sample (e.g., percentage of the sample who were confirmed to have been diagnosed with ADHD in childhood through parents).

The order of the survey and laboratory/interview measures was counterbalanced using randomization to eliminate order effects. There were small correlations between Order and the Revised Alcohol Expectancy Questionnaire (R-AEQ) (r = 0.24, p < .05) and the Test of Variables of Attention (T.O.V.A.) total response time (r = 0.28, p < .05). Specifically, completing the lab portion of the survey first was correlated with higher total scores on the R-AEQ and longer T.O.V.A. response times. However, upon linear regression analysis, these order effects were no longer significant and there was no indication of order effects on any other variables. All participants who provided full consent completed an online survey containing demographic information, ADHD history including diagnosis and treatment, prescription ADHD medication use (current), ADHD symptom measures, psychosocial functioning measures, history and current alcohol and other drug use as well as substance-related negative consequences, peer substance use, alcohol and other drug expectancies, measures of impulsivity and sensation seeking, an executive functioning measure, and academic and college student adjustment measures.

In terms of survey validity, there were a total of 10 validity items embedded throughout the survey that contained a correct and incorrect response. For example, "I am taking a survey right now, "Yes or No". Upon initial data analysis, 65 out of 66 participants answered the validity questions with 100% accuracy, with the other participant only missing one question (90% accuracy). In addition, the amount of time it took to complete the survey was measured using several research assistants and other graduate students who were asked to complete the survey as fast as possible, while still reading and accurately responding to all the questions. Their response times were recorded as follows: 23.03 min, 21.78 min, 27.16 min, 20.11 min, 24.33 min. These times were then averaged, and they produced a minimum response time of 23.28 min. All participants in the study sample recorded a response time over 23.28 min and therefore were considered valid responders.

In addition, participants completed laboratory measures administered by a member of the research team. During this portion of the session participants were first administered the T.O.V.A. Participants also completed a structured interview with a trained doctoral student clinician using the DSM-5 criteria to assess current ADHD diagnosis. Finally, participants were asked several qualitative questions about their perceptions on ADHD college student needs, substance abuse risk among ADHD students, and the role they felt substance use plays in academic and psychosocial functioning.

The laboratory part of the study took approximately one hour and 15 minutes to complete, making the total completion time for the study approximately 1.5hrs to 2hrs, depending on how quickly the participant was able to work through the survey. Upon completion of the study all participants were awarded two class credits if recruited through the online SONA system, and those who were recruited through other means were given a 5-dollar gift card. Towards the end of data collection, IRB approval was obtained to give participants 10-dollar amazon gift cards. Three participants received the 10-dollar gift card. If participants decided to stop participating in the study at any time they were not to be penalized and would still be awarded credit hours based on the amount of time they stayed to participate or a gift card; however, no participants stopped participating during the study.

After their participation, all participants were provided with general information regarding ADHD college students and substance use risk. Within this debriefing, the clinician investigator briefly explained the literature linking ADHD and substance use risk and difficulties associated with misuse/diversion of ADHD medication. All participants were also provided with a written handout on resources for both academic assistance and personal counseling for substance use, ADHD coaching, and/or other adjustment difficulties.

Measures

Upon obtaining informed consent, participants completed both the online survey and laboratory measures in a randomized order. The following is the list of all measures organized by measure type. For each measure, it is indicated as a "Survey" or "Lab" measure to distinguish which measures were self-reported through the online survey versus administered by a member of the research team. The one exception was the other report BARRS-IV childhood symptoms measure, which was collected via phone interview of the participant's parent or legal guardian, after they had an opportunity to tell them to expect this contact.

Demographics Form (Survey). The demographics form included the following information: age, academic standing, sex, gender, ethnicity, fraternity/sorority affiliation, living situation, and self-reported high school and current GPA.

ADHD Measures

Self-report age of diagnosis and treatment history (Survey). Participants were asked (to confirm) if they had ever been diagnosed with ADHD by a doctor or other health professional and when this diagnosis was made. In addition, participants were asked about any other mental health diagnosis they had received, prior treatment (including treatment type), and current medication use.

The Adult ADHD Self-Report Scale (ASRS; Schweitzer, Cummins, & Kant, 2001) (Survey) is an 18-item self-report measure of current ADHD symptoms. Individuals are asked to rate on a 5-point Likert scale (Never=0 to Very Often=4) how often they have experienced inattention and hyperactivity symptoms of ADHD in the past six months. Reliability and validity have been well established for using this measure among adults 18-years or older (Adler, Spencer, Faraone, Kessler, Howes, Biederman, & Secnik, 2006). Internal consistency is reported as high for both patient and rater-administered versions (Cronbach's alpha 0.88, 0.89, respectively). The Intraclass Correlation Coefficients (ICCs) between scales for total scores and for subset symptom scores have also been reportedly high (0.84, 0.83, respectively). In the current sample, internal consistency was good for the total score (Cronbach’s alpha 0.88) and was average for the Inattention (Cronbach’s alpha 0.80) and hyperactivity/impulsivity (Cronbach’s alpha 0.79) subscales.

The Barkley Adult ADHD Rating Scale, fourth edition, childhood symptoms, self-report (BARRS-IV; Barkley, 2011) (Survey) was completed as a self-report measure of ADHD symptoms in childhood. The BAARS-IV has been empirically supported as a measure of diagnostic symptoms of ADHD using the DSM-IV (Barkley, 2011). In addition, Davidson (2008) in a review paper concluded the BARRS-IV could be used in conjunction with other assessment tools in aiding in the diagnosis of ADHD and generally it is considered a reliable and valid measure of ADHD. Internal consistency in the original sample of adults was measured at .95 for childhood ADHD symptom scores on the self-report form (Barkley, 2011). In the current sample, internal consistency was good for the total score (Cronbach's alpha 0.89).

The Barkley Adult ADHD Rating Scale, fourth edition, childhood symptoms, other report (BARRS-IV; Barkley, 2011) (Phone) was completed by a parent or legal guardian of the participant as a measure of ADHD symptoms in childhood. The present study used the BAARS-IV: Other-Report: Childhood Symptoms, to collect data from participants' parents after consent. However, because of IRB stipulations, the information gathered through this phone interview could not be linked to the participants' data. The BAARS-IV has been empirically supported as a measure of diagnostic symptoms of ADHD using the DSM-IV (Barkley, 2011), and is considered a reliable and valid measure to use to aid diagnosis of ADHD (Davidson, 2008). Internal consistency is consistent with the BARRS-IV self-report (Cronbach's alpha = .95). In the current sample, internal consistency was good for the total score (Cronbach's alpha 0.86).

The Test of Variables of Attention (T.O.V.A.; Greenberg, Kindschi, & Corman, 1996) (Lab) is a computerized, objective measure of attention and inhibitory control normed by gender for ages 4 to over 80. Participants are asked to respond by clicking a micro-switch each time they see a black square towards the top of the screen versus the bottom of the screen. Participants are asked to respond as quickly as possible, while still attaining accuracy. The T.O.V.A. is a Continuous Performance Test (CPT) that calculates response time (speed), response time variability (consistency), commissions (impulsivity), and omissions (focus and vigilance) and compares these to a normative sample. Further, the adult test includes an embedded measure of validity (symptom exaggeration) and is considered useful in aiding in the diagnostic process of ADHD (Forbes, 1998).

There is some research indicating the T.O.V.A. can be used to identify individuals with ADHD in substance abuse outpatient facilities and other studies showing that poor response inhibition is a predictor for problem drinking and illicit drug use among adolescents (Nigg, Wong, Martel, Jester, Puttler, Glass, ... & Zucker, 2006). However, to the investigator's knowledge there is no research assessing use of T.O.V.A. scores in predicting substance use and associated consequences as well as psychosocial and academic functioning among college students. It was used in the present study as an additional objective measure of attention difficulties.

The Structured Clinical Interview for DSM-5, Clinical Version (SCID-5-CV; First, Williams, Karg, & Spitzer, 2015) (Lab) is a structured clinical interview used to identify disorders utilizing DSM-5 criteria among adults ages 18 and older. The SCID-5 was used in this study to assess current ADHD diagnostic criteria among the sample. Reliability and validity of previous versions of the SCID have been reported as adequate; and as this was the most updated version it was thought to be the most appropriate measure to use as a diagnostic interview for ADHD in this sample.

Substance Use and Associated Consequences Measures

The Drug Use History Questionnaire (**Sobell, Kwan, & Sobell, 1995)** (Survey) assesses a variety of drugs used including alcohol by asking a series of questions for each drug category including: "Ever Used" (yes/no), "Age first Use", "Total Years Used", and "Year Last Used". Finally, for each drug category "frequency of use in last 6 months" is assessed, with a response set from 0 (No use) to 7 (Daily use). Alcohol use can also be assessed with this measure, which is brief and easy to administer in the college population. This measure is considered a reliable way to gather data on an individual's alcohol and other drug use history (Sobell et al., 1995).

The Quantity-Frequency Index (QFI) (Survey) was used to assess quantity and frequency of alcohol and other drug use. There are a variety of ways to measure quantity and frequency of substance use. For the present study, respondents were asked about their alcohol use with the question "Over the last 3 months, on how many days did you drink (use a specific drug) per week?". Respondents selected from a Likert scale (0 – 9), including the options: none, one day, two days, three days, 1 day/week, 2 days/week, 3 days/week, 4 days/week, 5 days/week, and 6-7 days/week. In addition, after defining a standard drink, quantity of alcohol use was assessed by asking respondents "what was the greatest number standard drinks you drank in one day, over the last three months?", with a scale ranging from zero to 9+. Further, respondents were asked "over the last three months, on how many days did you drink the number of drinks indicated for the greatest number of standard drinks you drank in one day?". The same 0 – 9 Likert scale for frequency of drinking was used. Finally, respondents were asked "over the last three months, how many standard drinks did you usually drink on days when you drank?", selecting from a scale ranging from zero to 9+. From responses to these questions, a total alcohol consumption score (estimated standard drinks per the last 3 months) was derived.

In terms of drug use frequency, participants selected from a similar Likert scale (0 – 9), including the options: none, one day, two days, three days, 1 day/week, 2 days/week, 3 days/week, 4 days/week, 5 days/week, and 6-7 days/week, asking for their drug use frequency over the last 3 months for a variety of drug categories (e.g., marijuana, cocaine/crack, benzodiazepines, opioids, etc.). Reliability and validity for the use of the QFI as a measure of quantity and frequency of alcohol and other drug use has been adequately demonstrated (Cahalan, Cisin, & Crossley, 1969; Lemmens, Tan, & Knibbe, 1992). In addition, participants reported if they misused any ADHD stimulant medication in the last year. Misuse was defined as: Not taking as prescribed or using someone else's prescription.

The Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989) (Survey) is a 24-item measure developed to assess negative consequences of alcohol use among adolescents which has been used in many previous studies to predict negative consequences related to alcohol use among college students (Martens, Neighbors, Dams-O'Connor, Lee, & Larimer, 2007). The RAPI asks Individuals to rate negative consequences as a result of drinking that have happened to in the last year on a 5-point Likert scale, ranging from never, to 7 or more times. To date, there has been one article that examined the factor structure of the RAPI, finding three distinct factors: Abuse/Dependence, Personal Consequences, and Social Consequences (Martens et al., 2007). However, a total score is most frequently used when utilizing the RAPI. The RAPI has been shown to be a reliable and valid measure assessing a wide array of alcohol-related problems and has been used in various studies with a variety of populations including college students (Ginzler, Garrett, Baer, & Peterson, 2007; White & Labouvie, 1989). Further, there are good internal consistency scores for the scales as outlined by Martens et al. (2007): Abuse/Dependence, Personal Consequences, and Social Consequences (Cronbach's alphas = .75, .73, and .68, respectively). In the current sample, internal consistency was high for the total score (Cronbach's alpha 0.92).

The Short Index of Problems Drug Use (SIP-D; Blanchard, Morgenstern, Morgan, Lobouvie, & Bux, 2003) (Survey) was developed from longer measures of alcohol and substance use consequences. Each question is aimed at assessing a drug use negative consequence including physical problems (e.g., my physical appearance has been harmed by my drug use), interpersonal problems (e.g., while using drugs I have said harsh or cruel things to someone), intrapersonal problems (e.g., when using drugs my personality has changed for the worse), impulse control issues (e.g., when using drugs, I have done impulsive things that I regretted later), and social control issues (e.g., I have failed to do what is expected of me because of my drug use), and a total score can be calculated. Participants were asked to answer each item "yes" if they had experienced that consequence in the past year, and a total score was derived from the number of consequences endorsed. There is evidence showing good reliability and validity when asking for alcohol and other drug consequences using this measure, with the SIP-D having a Cronbach's alpha of .97 for the total score (Alterman, Cacciola, Ivey, Habing, & Lynch, 2009). Factor analysis of the SIP-D has yielded 5 unique factors with fair to good internal consistency (physical problems = .64, interpersonal problems = .61, intrapersonal problems = .58, impulse control issues = .56, and social control issues = .62) (Allensworth-Davies, Cheng, Smith, Samet, & Saitz, 2012). In the current study, the total score was used as the measure of drug use negative consequences and internal consistency was high for this measure (Cronbach's alpha 0.94).

Psychosocial and Academic Functioning Measures

The Patient Health Questionnaire – 9; PHQ-9*; *(Kroenke, Spitzer, & Williams, 2001) (Survey) is a 9-item measure of current depressive symptoms. Individuals are asked to rate their experience of each symptom on a Likert scale from "Not at all" to "Nearly every day" in the last two weeks. Scores range from zero to three and are then summed to create a total score. Scores from 0-4 indicate minimal or no symptoms, 5-9 indicate mild symptoms, 10-14 indicate moderate symptoms, 15-19 indicate moderately severe symptoms, and 20-27 indicate severe symptoms. Although not a stand-alone diagnostic measure, many of the symptoms map on to DSM-5 criteria so that it is useful in screening for depression. Reliability and validity have been established for using this measure for individuals 18 and older (Kroenke et al., 2001). Specifically, among adults in a primary care setting internal consistency was reported at .89. In the current sample, internal consistency was high for the total PHQ-9 score (Cronbach's alpha 0.90).

The Generalized Anxiety Disorder – 7; GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006) (Survey) is a 7-item measure of current anxiety symptoms. Individuals are asked to rate their experience of each symptom on a Likert scale from "Not at all" to "Nearly every day" in the last two weeks. Scores range from zero to three and are then summed to create a total score. Scores from 0-5 indicate mild anxiety, 5-10 indicates moderate anxiety, 11-15 indicate moderately severe anxiety, and 15-21 indicate severe anxiety. The GAD-7 is also a respected screening measure with scores above 10 suggestive of an Anxiety Disorder although further assessment would be necessary to make a diagnosis. Reliability and validity have been established for using this measure with adults (Löwe, Decker, Müller, Brähler, Schellberg, Herzog, & Herzberg, 2008), with a Cronbach's alpha score of .89 among the general population. In the current sample, internal consistency was high for the total GAD-7 score (Cronbach's alpha 0.94).

The Student Adaptation to College Questionnaire (SACQ; Baker, & Siryk, 1989) (Survey) is a 67-item self-report inventory measuring student adjustment to college. The questionnaire is broken down into four scales including: Academic adjustment, Personal-emotional adjustment, Social adjustment, and Attachment (to the institution). A total adjustment score can be calculated by summing the scores for all of the scales. This questionnaire has been the most widely used measure of college student adjustment (Credé & Niehorster, 2012) and is considered reliable and valid with internal consistency scores ranging from .81 to .90 for the total score (Dahmus, Bernardin, & Bernardin, 1992). In addition, the total score and academic adjustment scale have been related to college grades and retention. The social adjustment scale relates to parent-child relationships and friends. For the purposes of this study the Social Adjustment and the Academic Adjustment Subscales were used to assess general functioning in these two domains. Good internal consistency has been established for both the Social Adjustment and Academic Adjustment subscales, with Cronbach's alpha scores ranging from .77 to .86, and from .83 to .91, respectively. In the current sample, internal consistency was only average (Cronbach's alpha 0.79) for the Academic Adjustment subscale but was high (Cronbach's alpha 0.91) for the Social Adjustment subscale.

General and Specific ADHD Predictors of Substance Use Measures

The Structured Clinical Interview for DSM, patient questionnaire (SCID-PQ – conduct disorder; Nussbaum, & Rogers, 1992) (Survey) is a 15-item yes/no questionnaire that asks about conduct problems in childhood, based on the DSM-IV criteria for conduct disorder (American Psychiatric Association, 2000); however, they also map onto DSM-5 criteria since there were no changes to this section. These childhood conduct questions taken from the SCID-II Personality Disorder screening instrument have been shown to be related to ADHD in childhood as well as associated with ADHD within an adult substance abuse sample (Stanton, Cellucci, Mochrie, & Lutes, 2015). In the current sample, internal consistency was average for the total history of conduct problems score (Cronbach's alpha 0.75).

The Perceptions of Peer Substance Use measure (Adapted from Van Eck, Markle, Dattilo, & Flory, 2014) (Survey) consists of 9-items that assess perceived peer substance use. These items were originally from the Monitoring the Future study (Johnston, O'Malley, & Bachman, 1988) and were then adapted by Chassin, Pillow, Curran, Molina, & Barrera, (1993). However, for the purpose of this study a further adapted measure by Van Eck et al. (2014) was used to assess this domain. Using Van Eck's model, perceived peer-use items (9 items) are measured on a 6-point scale (1 – None of my friends to 6 – All of my friends). Three subscales are included, peer perceptions of alcohol use (4-items), peer perceptions of marijuana use (3-items), and peer perceptions of other illicit drug use (2-items). These scores were then summed to create a total perceived peer substance use score, with higher scores indicating perceptions of higher substance use among peers. In the current sample, internal consistency was good for the total score (Cronbach's alpha 0.84).

The Revised Alcohol Expectancy Questionnaire (R-AEQ; Rohsenow, 1983) (Survey) is a 40-item measure of alcohol expectancies, which is broken down into eight subscales including: Global Positive, Social and Physical Pleasure, Social Expressiveness, Sexual Enhancement, Power and Aggression, Tension Reduction and Relaxation, Cognitive and Physical Impairment, and Careless Unconcern. The present study used the Global Positive (5-items) and Social and Physical Pleasure (5-items) subscales which have been most strongly predictive of drinking in college samples. The Global Positive subscale is intended to measure overall positive alcohol expectancies (e.g., Drinking makes the future seem brighter to me; Alcohol seems like magic to me, etc.). The Social and Physical Pleasure subscale is intended to measure positive expectancies of alcohol use related to social situations and positive physical sensations (e.g., Drinking makes me feel good; Some alcohol has a pleasant, cleansing, tingly taste to me, etc.). Respondents were asked to rate each item based on their current beliefs on a Likert scale ranging from “Strongly Disagree” to “Strongly Agree”. Internal consistency statistics were somewhat low in the original sample for the Global Positive (.49) and Social and Physical Pleasure (.66) subscales; however, these scale items are still considered good measures of college student alcohol expectancies (Rohsenow, 1983). In the present study these two subscales were combined to create a total positive expectancy drinking variable. This alcohol expectancy measure had good internal consistency in the present sample (Cronbach’s alpha 0.85).

The Marijuana Expectancies Questionnaire (MEQ; Kristjansson, Agrawal, Lynskey, & Chassin, 2012) (Survey) is a 34-item self-report measure of marijuana expectancies. All items are rated on a Likert scale from “Strongly Disagree” to “Strongly

Agree". Respondents are asked to rate each item on this scale in relation to what they currently believe about using marijuana. There are four separate subscales that have some overlap in items including: Global Positive Changes, Relaxation–tension Reduction, Cognitive-motor Enhancement, and Cognitive Behavioral Impairment. The Global Positive Changes subscale includes 20-items, with a Cronbach's alpha of .97 among a sample of adults, has demonstrated good reliability and validity in adult samples (Kristjansson et al., 2012) and is used to measure overall positive marijuana expectancies (e.g., Helps cheer me up when I'm in a bad mood, Makes parties more fun, etc.). The present study used the Global Positive Changes subscale to measure positive marijuana expectancies. In the current sample, internal consistency was very high for the Global Positive Changes Subscale (Cronbach's alpha 0.98).

The Sensation Seeking Scale (Thrill and Adventure Seeking subscale; SSS-TAS; Zuckerman, Eysenck, & Eysenck, 1978) (Survey) is a 40-item self-report measure of sensation seeking personality traits. All items are in a forced-choice format. For the purpose of the present study the TAS subscale (10-items) was used to assess thrill seeking and adventure-driven personality traits among the sample. Many studies have linked sensation seeking to risky behavior such as alcohol and other drug use (Jaffe, & Archer, 1987; Zuckerman, 1994;). Further, the TAS subscale is considered a reliable and valid personality measure among college students and adults (Roberti, Storch, & Bravata, 2003). A Cronbach's alpha of .80 was reported for the TAS subscale in a sample of college students, suggesting good internal consistency for this subscale in this population. Unfortunately, In the current sample, internal consistency was very low for this TAS subscale (Cronbach's alpha 0.15).

The Short UPPS-P Impulsive Behavior Scale (SUPPS-P; Lynam, 2013) (Survey) is a shortened version of the UPPS-P (Lynam, Smith, Whiteside, & Cyders, 2006) which contains five facets including: sensation seeking, lack of premeditation, lack of perseverance, negative urgency, and positive urgency. The original version was condensed from 51-items to 20-items to make the shortened version. On the SUPPS-P there are 4-items per scale, which have all been shown to be linked to impulsivity. Thus, for the purpose of the present study the SUPPS-P, Positive Urgency Subscale was used as a measure of impulsivity. In addition, for the purpose of the present study the SUPPS-P, Negative Urgency Subscale was used as a measure of emotion dysregulation. The SUPPS-P has been used widely among college undergraduate students and has demonstrated good reliability and validity with internal consistency values between .74 – .88 across all subscales (Cyders, Littlefield, Coffey, & Karyadi, 2014; Lyman, 2013). In the current sample, internal consistency was average for this brief scale (Cronbach’s alpha 0.72).

The Barkley Deficits in Executive Functioning Scale – Children and Adolescents (B-DEFS-CA; Barkley, 2012) (Survey) is a 70-question self-report scale based on executive functioning theories (Barkley, 1997) and was tailored to assess executive functioning in children and adolescents with ADHD. The items focus on problematic symptoms (deficits) that individuals experience on a regular basis. Participants rated the frequency of various behavioral difficulties over the last six months and were prompted to consider their typical behavior when not under the influence. There are five executive functioning dimensions assessed through a 0–3 Likert scale (0=rarely or not at all to 3=very often). These dimensions include self-management to time, self-organization/problem solving, self-restraint (inhibition), self-motivation, and self-regulation of emotions.

The internal consistency of each B-DEFS-CA subscales has been reported as high, ranging from .91 to .96, including the total score (Allee-Smith, Winters, Drake & Joslin, 2013). The B-DEFS-CA was inadvertently used in the current sample instead of the B-DEFS for adults (Barkley & Murphy, 2011). However, this was still thought to be a valid measure of executive functioning deficits among this group of college students, due to the majority of them being Freshman. Further, the constructs that are measured in the both the B-DEFS-CA and B-DEFS adult version are largely the same. Moreover, In the current sample, internal consistency was high for the total B-DEFS-CA score (Cronbach's alpha 0.97).

***Qualitative Questions*.** Finally, participants were asked to respond within a brief interview after data collection to several qualitative questions. They were advised that these questions were general and not necessarily about themselves. The following six questions were asked: 1) What do you perceive to be the major concerns or challenges for ADHD college students? 2) What do you see as their perceived needs? 3) Are substance use risks and associated consequences different among ADHD and non-ADHD students and how so? 4) How do you see substance use affecting the academic and psychosocial functioning of ADHD college students? 5) What do you think might be done to reduce the risk of substance abuse among those with ADHD? 6) What could be done generally to better help students with ADHD succeed in college?

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS for Windows, Versions 24 and 25 SPSS Inc). Cronbach alphas were reported for all measures to assess internal consistency within this sample. In addition, the researchers used total scores in analyses versus subscale scores, unless specifically indicated in the measures section. Missing data were obtained on several survey measures including the ASRS, SCIDPQ (Conduct problems), RAPI, MEQ, SIP-D, GAD-7, SACQ (academic and social adjustment), S-UPPSP, and the B-DEFS-CA. Upon reviewing the distribution of missing data, it was determined that mean and median substitution were able to be used for all missing data (Kang, 2013).

The major research questions were aimed at describing ADHD college student substance use and associated consequences as well as their psychosocial and academic functioning (*Aim 1*: Describe the substance use patterns and associated substance use negative consequences within this sample of ADHD college students including correlations between substance use variables) and (*Aim 3*. Describe the psychosocial and academic functioning of ADHD college students within the study sample as well as the relationship of ADHD specific predictors to psychosocial/academic difficulties).

Descriptive statistics were used to describe each of these domains including demographic information for the sample, past history and age of ADHD diagnosis and treatment, current substance use and associated consequences, current ADHD symptoms, and academic and psychosocial functioning. There were eight substance use variables computed and used in the analyses. These included: 1) current alcohol use (i.e., total consumption of alcohol use in the last 3 months from QFI), 2) binge drinking (i.e., reported binge drinking in the last 3 months), 3) current marijuana use (i.e., frequency of use in last 3 months), 4) regular marijuana user (i.e., reported using at least once per week in last 3 months), 5) ADHD stimulant prescription misuse (i.e., reported misusing ADHD stimulant prescription medication at least once in the last year), 6) current other illicit use (i.e., reported using at least one illicit substance besides alcohol, marijuana, and/or ADHD stimulant medication in last 3 months), 7) current alcohol problems (i.e., total score on the RAPI), and 8) current drug problems (i.e., total score on the SIP-D).

In terms of psychosocial and academic functioning five dependent or criterion variables were computed and used for analyses. For psychosocial functioning these included: 1) depression (i.e., total score on the PHQ-9), 2) anxiety (i.e., total score on the GAD-7), and 3) social adjustment to college (i.e., total score on the social adjustment subscale of the SACQ). Criterion variables for academic adjustment included: 1) current college GPA and 2) academic adjustment to college (i.e., total score on the academic adjustment subscale of the SACQ).

Pearson correlation analyses were used to examine associations among measures between the previously mentioned domains. Potential demographic covariates were identified and controlled for in answering the main research questions. These included current age, sex, current year in college, and (where specified) a history of conduct problems. Current medication status was not used as a covariate based on prior research showing no relationship between medication and substance use (Mochrie et al., 2018). Moreover, medication status did not correlate with the five criterion adjustment variables in the present sample.

Specifically, for the substance use prediction research question (*Aim 2*. Assess the relationship of general substance use predictors and ADHD specific predictors to substance use patterns and substance use negative consequences among an ADHD college student sample), correlations were calculated between general and ADHD specific predictors of substance use (outlined in the measures section above) and current substance use and substance use negative consequences. The hypotheses associated with these Aims were analyzed using Logistic and Linear regression analyses to predict the various outcome or criterion variables. Moreover, in assessing general and ADHD specific predictors, multicollinearity between predictors was examined and determined to be low, suggesting that the predictor variables could be entered separately within the same regression models.

After examining predictors separately, exploratory analyses were conducted using multiple regression analysis to identify best overall models examining all significant general and ADHD specific predictors of substance use and associated consequences within single models (*Aim 2*. Hypothesis 3: An exploratory analysis using both general and ADHD specific predictors within a single model will be conducted. It was hypothesized that there would be significant ADHD specific predictors which might account for additional variance in substance use and associated consequences above that of general predictors). In order to compare odds ratios among predictors, variable scores were standardized. In addition, where there were significant findings, analyses were rerun with controlling variables entered including age, sex, current year in college, and history of conduct disorder (based on prior research) to see if predictors remained significant.

In addition, severity of ADHD symptoms (using the ASRS) was used in exploratory moderation analyses with substance use (i.e., current alcohol consumption, binge drinking status, current marijuana use, classification as a regular marijuana user, and Other Illicit drug use) to explore the interaction of ADHD symptoms and substance use on negative alcohol and drug consequences using the Hayes (2013), model (described below). (*Aim 2*. Hypothesis 4: It was hypothesized that greater ADHD severity of symptoms (i.e. ASRS) would interact with higher levels of substance use variables described above to significantly predict more alcohol and drug-related negative consequences).

Next, the relationship between ADHD specific predictors (i.e., ASRS, T.O.V.A. variables, SUPPS-P Positive and Negative Urgency Subscales, BDEFS-CA) and psychosocial functioning (i.e., PHQ-9, GAD-7, SACQ – Social Adjustment Subscale) was assessed (*Aim* 3). Further, the relationship between the ADHD specific predictors and academic functioning (i.e., Current GPA, SACQ – Academic Adjustment Subscale) was also assessed. Zero-order correlations were calculated before running linear regression analyses. In addition, where there were significant findings, analyses were rerun with controlling variables entered including age, sex, current year in college, and history of conduct disorder (based on prior research) to see if predictors remained significant.

Finally, a series of moderation analyses (Hayes, 2013) were also conducted to determine the degree to which substance use influences the relationship between ADHD specific predictors and psychosocial and academic functioning (*Aim 4*. Assess the impact of substance use on psychosocial outcomes and academic functioning within a sample of all ADHD college students). These analyses were run using the PROCESS

Macro and SPSS (Version 24, Greenville, NC). This allowed for a bootstrapping technique for each analysis to be completed. Bootstrapping using the PROCESS Macro generated 5,000 random samples with replacement from the data set. The predictor variables in the moderation analyses were participant's scores for severity of ADHD symptoms (ASRS, T.O.V.A.), impulsivity (S-UPPS), and executive functioning deficits (B-DEFS-CA). The moderator was substance use status (i.e., substance use variables: current alcohol use, binge drinking, current marijuana use, regular marijuana user). Finally, functioning was the outcome variable including both psychosocial and academic functioning (i.e., PHQ-9, GAD-7, SACQ – psychosocial adjustment), and academic functioning (i.e., Self-reported GPA, SACQ – Academic adjustment).

The *p*-value associated with the interaction term in each moderation analysis was examined to see if there were any significant interactions. In addition, the R^2 change value was assessed. If there was a significant R^2 change value for the interaction term, this indicated a moderation effect. Finally, any moderation effects that were determined included further examination of the influence of the predictor and the outcome at each level of the moderator.

Statistical Power Analysis

A power analysis using the statistical software G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) was conducted to determine sample size requirements for completing the proposed analyses above. All estimates assumed an α of .05. There were several multiple regressions run for the purposes of the present study. The maximum number of possible predictors used in any proposed multiple regression was used to calculate the needed sample sizes for the analyses using G*Power 3.1. This program was used to identify the necessary sample size to detect a large effect size (f^2 = .35, α = .05) with 80% power. As these variables have been found to be related in prior research, the study was looking for large effects. The largest possible multiple regression that was proposed included 11 possible variables (up to two covariates, if all variables were significant). The predictors would include all general predictors and ADHD specific predictors of substance use within a single model, with two covariates. Thus, a sample size of 59 was estimated to obtain appropriate power. *Table 3* displays the power analysis in more detail.

Table 3. G-power analysis for adequate sample size

Input Parameters	Output Parameters
Effect Size (F^2) = .35 (large effect)	Noncentrality parameter = 20.65
α = .05	Critical F = 1.99
Power = 0.80	Numerator df = 11 Denominator df = 47
Number of predictors = 11	Total sample size = 59

Analysis: Linear Multiple Regression

Qualitative Data Analysis

Finally, participants' responses to the Qualitative questions about ADHD, substance use, and college student functioning were analyzed in terms of major themes. It was thought important to ask the participants to describe their own experiences and challenges with having ADHD and being in college. Since these questions were exploratory, only the major themes across participants were described. The open-ended responses to six qualitative questions were summarized using a semi-directed approach to content analysis (Hsieh, & Shannon, 2005) in that prior literature suggested initial categories that were revised during data analysis.

First, the PI and project supervisor reviewed the responses made and clarified item content. After reviewing the responses and discussing preliminary categories (a number of responses fell across several), two different independent raters then coded the individual responses into agreed upon categories, and then met to discuss and reach agreement on differences in classification. In addition, these independent raters were trained by the PI in rating responses by participating in a practice coding created by the PI. Generally, unless viewed as an oversight, themes had to be clearly present to both raters to be scored as including that category. If there was disagreement between the two reviewers, the PI made a final decision on what category a response was coded into. There were various responses for each of the qualitative questions that did not neatly fall into a category, so the category of “other” was created for each question. Interrater reliability was reported for each qualitative question. Percentages for the frequency with which a category theme was mentioned in qualitative responses are provided.

Chapter IV: Results

This chapter will systematically describe the study findings. Initially, I provide descriptive data on study participants including their reported ADHD history and current symptoms and then proceed to report their current substance use patterns (Aim 1). In addition, I report on the relationship between current substance use and associated negative consequences as well as misuse of ADHD stimulant medication in the sample.

Next, I report on the relationship of general substance use predictors (i.e., substance use history, history of conduct problems, peer influence, positive expectancies, and sensation seeking) to current substance use and associated consequences (Aim 2). Further, I also report on the relationship of specific ADHD factors (i.e., severity of ADHD symptoms on ASRS and T.O.V.A., impulsivity and emotion dysregulation, and executive functioning deficits) to current substance use and associated consequences. In addition, as part of this Aim, I report on exploratory analyses which include the best models of both general and ADHD specific predictors of current substance use and consequences. Finally, the interaction of ADHD symptoms (ASRS) with general predictors on substance use negative consequences is examined using moderation analysis.

I will then provide further descriptive data on study participants as to their reported psychosocial and academic adjustment to college (Aim 3). In addition, I report on the relationship between ADHD specific factors and psychosocial/academic functioning using regression analysis. Finally, I examined the impact of substance use on psychosocial outcomes and academic functioning (Aim 4). I also report on moderation analyses to assess the possible interactive influence of substance use on the relationship between ADHD specific factors and psychosocial/academic functioning.

Finally, descriptive statistics on identified themes are reported for the qualitative questions.

ADHD History and Symptoms of Participants

Participants were a recruited sample of 66 university students who all reported having a history of diagnosed ADHD. On average, participants reported being 11.48 (SD = 4.29) years old at the time they received an ADHD diagnosis. Participants most often reported being diagnosed by a Physician (56.1%) followed by Psychological Evaluation (43.9%), Psychiatrist (39.4%), Educational Specialist = 9 (13.6%), Counselor/Therapist (12.1%), and School Psychologist (10.6%), with 42.4% reporting they were diagnosed by at least two of the persons described above. Interestingly, 62 (~94%) individuals reported a history of being prescribed an ADHD medication; however, only 39 (~59%) reported currently being prescribed medication. Approximately half the sample (53%) reported a history of school accommodations. A full description of ADHD characteristics of participants can be found in *Table 4* below.

Table 4. ADHD Self-Report Descriptive Statistics

ADHD Variables	N (% of sample)
Self-reported Diagnosis of ADHD	66 (100%)
Age of Diagnosis	Range = 4 to 24 years *M* = 11.48; SD = 4.29
Professional Diagnosis	General Physician = 37 (56.1%) Psychological Evaluation (Testing) = 29 (43.9%) Psychiatrist = 26 (39.4%) Educational Specialist = 9 (13.6%) Counselor/Therapist = 8 (12.1%) School Psychologist = 7 (10.6%)

ADHD Prescribed Medication History	Yes = 62 (93.9%) No = 4 (6.1%)
Currently on Medication for ADHD	Yes = 39 (59.1%) No = 27 (40.9%)
Number of Years on Medication	Range = 0 to 16 *M* = 5.38 years; SD = 4.09
History of Psychological Treatment for ADHD	Yes = 20 (30.3%) No = 46 (69.7%)
History of Accommodations/Special Services	Yes = 35 (53.0%) No = 31 (47%)

As stated above, an attempt was made to confirm ADHD diagnosis via parent report and use of the BARRS-IV Childhood Other rating scale. In addition, all participants filled out the BARRS-IV Childhood self-report measure on themselves. Interestingly, on the BARRS-IV Childhood self-report measure, 60.6% of the sample met symptom count criteria for having a diagnosis of ADHD in childhood. The majority of these participants endorsed meeting symptom count criteria for ADHD combined presentation in childhood (n = 21). Fifteen endorsed meeting symptom count criteria for ADHD inattentive type and four for hyperactive/impulsive type in childhood. A detailed description of these results can be found in *Table 5.*

Table 5. The Barkley Adult ADHD Rating Scale, fourth edition, Self-Report Childhood Symptoms (BARRS-IV).

Self-report BARRS-IV Childhood Symptoms	N (% of Sample)
BARRS-IV Total Score	Range = 27 to 69 (*M* = 47.95; SD = 10.56)

BARRS-IV: ADHD Symptom Count	Symptom Count Criteria Met: 40 (60.6%) Symptom Count Criteria NOT Met: 26 (39.4%)
BARRS-IV: Inattentive Type	Symptom Count Criteria Met: 15 (22.7%) Symptom Count Criteria NOT Met: 51 (77.3%)
BARRS-IV: Hyperactive/Impulsive Type	Symptom Count Criteria Met: 4 (6.1%) Symptom Count Criteria NOT Met: 62 (93.9%)
BARRS-IV: Combined Type	Symptom Count Criteria Met: 21 (68.2%) Symptom Count Criteria NOT Met: 45 (31.8%)

As explained earlier, parent report and BARRS-IV Childhood Other Reports were available for over 90% of the sample. All the parents/guardians contacted (100%) confirmed that their child had been diagnosed with ADHD. According to their BARRS-IV Other Symptom Reports, a similar percentage (65%) met ADHD Symptom criteria on this measure. Twenty-four met criteria for Inattentive type, five Hyperactive/ Impulsive type, and ten Combined type. Specific findings from the BARRS-IV Other (parent) report can be found in *Table 6*.

Table 6. The Barkley Adult ADHD Rating Scale, fourth edition, Other-Report Childhood Symptoms (BARRS-IV)

Parent-report BARRS-IV Childhood Symptoms	N (% of Sample)
Parent-report of ADHD Diagnosis	60 (100%) Reported Child was previously diagnosed with ADHD
BARRS-IV Total Score	Range = 12 to 64 (*M* = 43.87; SD = 10.31)
BARRS-IV: ADHD Symptom Count	Symptom Count Criteria Met: 39 (65.0%) Symptom Count Criteria NOT Met: 21 (35.0%)
BARRS-IV: Inattentive Type	Symptom Count Criteria Met: 24 (40%)

	Symptom Count Criteria NOT Met: 36 (40.0%)
BARRS-IV: Hyperactive/Impulsive Type	Symptom Count Criteria Met: 5 (8.3%) Symptom Count Criteria NOT Met: 55 (91.7%)
BARRS-IV: Combined Type	Symptom Count Criteria Met: 10 (16.7%) Symptom Count Criteria NOT Met: 50 (83.3%)

Participants also reported on their current symptoms of ADHD on the ASRS and SCID-5. On the ASRS, 95.5% of the sample was classified as being highly likely to currently have ADHD. The ASRS allows scores to be further broken down into classification categories between Inattentive and Hyperactive/Impulsive types of ADHD. These scales indicated that 95.5% of the participants were classified as highly likely to currently have ADHD inattentive type, while 71.2% were highly likely to have hyperactive/impulsive type. The findings from the ASRS can be found in *Table* 7.

Table 7. Adult ADHD Self-Report Scale, Current Symptoms

ASRS Variables	N (% of Sample)
ASRS Total Scores	Range: 23 to 89 (*M* = 59.20; SD = 11.86)
ASRS Inattention Total Score	Range: 12 to 45 (*M* = 32.15; SD = 6.03)
ASRS ADHD Classification Categories	Highly Likely to Have ADHD: 63 (95.5%) Likely to Have ADHD: 2 (3.0%) Unlikely to have ADHD: 1 (1.5%)
ASRS Inattention Classification Categories	Highly Likely to Have Inattention ADHD: 63 (95.5%) Likely to Have Inattention ADHD: 2 (3.0%) Unlikely to have Inattention ADHD: 1 (1.5%)
ASRS Hyperactivity Classification Categories	Highly Likely to Have Hyperactive ADHD: 47 (71.2%) Likely to Have Hyperactive ADHD: 11 (16.7%) Unlikely to have Hyperactive ADHD: 8 (12.1%)

Current diagnostic status was also ascertained by a DSM-5 structured clinical interview although current diagnosis was not an inclusion criterion for study participation. On the SCID-5 ADHD diagnostic interview measure, 81.8% of the sample were rated as having met current criteria for ADHD. This is further broken down by type on *Table 8.*

Table 8. The Structured Clinical Interview for DSM-5, ADHD

SCID-5 for ADHD, Current Symptoms	N (% of Sample)
Criteria met for ADHD Current Diagnosis	Yes = 54 (81.8%) No = 12 (18.2%)
Criteria met for Current Inattentive Type	Yes = 5 (7.6%) No = 61 (92.4%)
Criteria met for Current Hyperactive Type	Yes = 14 (21.2%) No = 52 (78.8%)
Criteria met for Current Combined Presentation	Yes = 35 (53.0%) No = 31 (47.0%)

Participants were also queried as to other possible comorbid diagnoses. In terms of comorbid diagnoses, 21 participants reported a history of another mental health diagnosis and 3 participants reported a history of a learning disorder diagnosis. The most common mental health diagnoses among those who reported a history of a comorbid disorder were anxiety (21.1%) and depression (18.2%). Approximately 88% of these individuals reported currently experiencing associated symptoms/difficulties. Interestingly, only one participant reported a history of substance use disorder. Seventy-five percent reported a treatment history for a comorbid diagnosis and 33% were currently prescribed associated medication. A full description of comorbid disorders can be found in *Table 9* below.

Table 9. Comorbid Diagnoses

Comorbid Diagnoses	N (% of sample)
History of Other Mental Health Diagnoses	Yes = 21 (32.8%) No = 43 (67.2%)
History of Learning Disorder	Yes = 3 (4.7%) No = 61 (95.3%)
Specific Diagnoses	Anxiety = 14 (21.2%) Depression = 12 (18.2%) Dyslexia = 3 (4.5%) Dysgraphia = 1 (1.5%) Anorexia = 1 (1.5%) Tourette's Syndrome = 1 (1.5%) Adjustment Disorder = 1 (1.5%) Substance Abuse = 1 (1.5%) Insomnia = 1 (1.5%) OCD = 1 (1.5%)
Treatment History	Yes = 18 (75%) No = 6 (25%)
Experiencing Current Symptoms/Difficulties	Yes = 21 (87.5%) No = 3 (12.5%)
Current Medication for the Diagnosis	Yes = 8 (33.3%) No = 16 (66.7%)

Aim 1: Substance Use Patterns and Associated Negative Consequences

Descriptive statistics were used to report participant's substance use patterns and negative consequences. Further, correlations were used to assess relationships between current substance use and associated negative consequences as well as misuse of ADHD stimulant medication in the sample and are reported below.

Alcohol Use. In the present study, 97% of participants reported they had used alcohol at some point in their lives, with 89.4% reporting alcohol consumption in the last 90 days. On average participants reported being approximately 16 (SD = 2.09; range 8-21 years) years old at the time they consumed their first alcoholic beverage. In terms of alcohol consumption over the last 90 days, the average number of days drinking reported was 14.73 (SD = 13.53). Total consumption over the last 90 days, calculated from the QFI ranged from 0 to 318 standard drinks, with a mean of 82.09 (SD = 89.85). In addition, approximately 20% of the sample reported drinking 14 or more standard drinks per week and 65.2% reported binge drinking (5+ standard drinks per occasion) in the last 90 days. A full description of participants' reported alcohol consumption can be found in *Table 10* below.

Table 10. Alcohol Consumption, Lifetime and in Last 90 Days

Alcohol Consumption Variables	N (% of Sample) or (Mean, Standard Deviation)
Ever Used	Yes: 64 (97.0%) No: 2 (3.0%)
Age of First Use	Range: 8 to 21 (*M* = 15.89; SD = 2.09)
Total Years Used	Range: 0 to 12 (*M* = 3.36; SD = 2.15)
Number of Days Drinking in Last 90 Days	Range: 0 to 60 (*M* = 14.73, SD = 13.53
Highest Number of Drinks Consumed in Last 90 Days	Range: 0 to 9+ (*M* = 5.71; SD = 3.23)
Number of Days Highest Number of Drinks	

Consumed in Last 90 Days	Range: 0 to 9+ (*M* = 3.03; SD = 2.64)
Typical Number of Standard Drinks Per Drinking Occasion in Last 90 Days	Range: 0 to 9+ (*M* = 3.74; SD = 2.61)
Total Consumption in Standard Drinks in Last 90 Days	Range: 0 to 318 (*M* = 82.09; SD = 89.85)
14 or More Standard Drinks Per Week in Last 90 Days	Yes = 13 (19.7%) No = 53 (80.3%)
Binge Drinker in Last 90 Days	Yes = 43 (65.2%) No = 23 (34.8%)

Marijuana Use. Approximately 72% of the sample reported having used marijuana at least once in their lifetime, with 56.9% reporting they used at least once in the last 90 days. On average, participants reported first using marijuana at 16.24 (SD = 1.83) years old. Those who reported using marijuana at least once a week or more in the last 90 days were classified as regular marijuana users. Approximately 36% of the sample were classified as regular marijuana users. A full description of participants' marijuana use can be found in *Table 11*.

Table 11. Marijuana Use

Marijuana Use Variables	N (% of Sample) or (Mean; Standard Deviation)
Ever Used	Yes = 47 (72.3%) No = 18 (27.7%)
Age of First Use	Range: 12 to 21 (*M* = 16.24; SD = 1.83)
Total Number of Years Used	Range: 0 to 6 (*M* = 2.42; 1.69)
Frequency of Use in Last 90 Days	Range: 0 to 25-30 times per month (*M* = 1.86; SD = 1.97)

Use at Least Once Per Week in Last 90 Days	Yes = 24 (36.4%) No = 42 (63.6%)

Nonprescription Use of ADHD Medication. Participants were asked specifically about non-prescribed use of ADHD medication as such misuse has been associated with alcohol and other drug use in college students. Interestingly, approximately 24% of the sample reported misusing ADHD prescription medication in the last year.

Other Illicit Drug Use. In terms of other illicit drug use (excluding marijuana and ADHD prescription misuse), participants most often reported a lifetime history of using Cocaine/Crack (n = 14), Amphetamines (n = 13), Hallucinogens (n = 13), and Benzodiazepines /Tranquilizers (n = 12). A full description of illicit drug use history can be found in *Table 12*. They also reported on their current use of other drugs. In the last 90 days, 19.7% of participants reported using an illicit substance other than marijuana or ADHD prescription medication. *Table 13* displays current illicit drug use by drug categories for the sample. Each category is broken down by how often participants reported using each type of drug in the last 90 days. Of those students who used other drugs, they most often were experimenting with hallucinogens or misusing tranquilizers.

Table 12. Illicit Drug Use History (Lifetime)

Illicit Drug Use History	N (% of Sample)
Ever Used Cocaine/Crack	Yes = 14 (21.2%) No = 52 (78.8%)
Ever Used Meth	Yes = 2 (3.0%) No = 64 (97.0%)

Ever Used Amphetamines (Not Prescribed)	Yes = 13 (19.7%) No = 53 (80.3%)
Ever Used Benzodiazepines/Tranquilizers	Yes = 12 (18.2% No = 54 (81.8%)
Ever Used Heroin	Yes = 1 (1.5%) No = 65 (98.5%)
Ever Used Other Opioids	Yes = 8 (12.1%) No = 58 (87.9%)
Ever Used Hallucinogens	Yes = 13 (19.7%) No = 53 (80.3%)
Ever Used Steroids	Yes = 1 (1.5%) No = 65 (98.5%)
Ever Used Other Prescription Drugs Illegally	Yes = 5 (7.6%) No = 60 (92.3%)

Table 13. Current Illicit Drug Use (Last 90 Days)

Illicit Drug Use in Last 90 Days	N (% of Sample)
Any Illicit Drug Use besides Marijuana and Prescription Stimulants	Yes: 13 (19.7%) No: 53 (80.3%)
Any Use of ADHD Stimulants in a Non-Prescribed Way	Yes: 16 (24.2%) No: 50 (75.8%)
Cocaine/Crack Use	Total Users: 6 (9.0%) Non-Users: 60 (90.9%) 1 day: 1 (1`.5%) 2 days: 1 (1.5%) 3 days: 2 (3.0%) 1 day per week: 2 (3.0%)
Stimulant Use (Not Prescribed)	Total Users: 9 (13.6%) Non-Users: 57 (86.4%) 2 days: 1 (1.5%) 2 days per week: 1 (1.5%) 5 days per week: 1 (1.5%) 6 to 7 days per week: 6 (9.1%)

Benzodiazepine/Tranquilizer Use	Total Users: 4 (6.0%) Non-Users: 62 (93.9%) 1 day: 3 (4.5%) 2 days per week (1.5%)
Heroin Use	Total Users: 1 (1.5%) Non-Users: 65 (98.5%) 3 days: 1 (1.5%)
Opioid Use	Total Users: 1 (1.5%) Non-Users: 65 (98.5%) 1 day: 1 (1.5%)
Hallucinogen Use	Total Users: 7 (10.6%) Non-Users: 59 (89.4%) 1 day: 4 (6.1%) 3 days: 2 (3.0%) 1 day per week: 1 (1.5%)
Inhalant Use	Total Users: 2 (3.0%) Non-Users: 64 (97.0%) 1 day: 2 (3.0%)
Steroid Use	Total Users: 1 (1.5%) Non-Users = 65 (98.5%) 2 days per week: 1 (1.5%)
Illicit Prescription Drug Use (Not Prescribed) Other than Stimulant Medication	Total Users: 5 (7.5%) Non-Users: 61 (92.4%) 1 day: 1 (1.5%) 2 days: 1 (1.5%) 1 day per week: 1 (1.5%) 2 days per week: 1 (1.5%) 5 days per week: 1 (1.5%)

Substance Use Consequences. Alcohol use consequences over the last 90 days were reported on the RAPI. Scores ranged from 0 to 47 (higher scores indicating more consequences), with average scores of 7.97 (SD = 11.16). In terms of drug use consequences scores on the SIP-D ranged from 0 to 29 (higher scores indicating more consequences), with average scores of 4.32 (SD = 7.25). *Table 14* displays more information on the RAPI and SIP-D for the sample.

Table 14. Rutgers Alcohol Problem Index and Short Index of Problems, Drug Use Scores Over Last 90 Days

Substance Use Consequences	N (% of Sample)
RAPI (Alcohol-Related Consequences)	Range: 0 to 47 out of possible 92 (*M* = 7.97; SD = 11.16)
Number of Participants Experiencing at Least One Negative Consequence due to Drinking	51 (77.3%)
SIP-D (Drug-Related Consequences)	Range: 0 to 29 out of possible 45 (*M* = 4.32; SD = 7.25)
Number of Participants Experiencing at Least One Negative Consequence due to Drug Use	36 (54.5%)

Relationship of Current Substance Use to Negative Consequences. As hypothesized (*Aim 1,* Hyp 1), current alcohol use was positively correlated with alcohol use consequences on the RAPI as displayed in *Table 15*. Those participants reporting higher levels of drinking also reported more negative consequences on the RAPI.

Table 15. Relationship of Alcohol Use to the RAPI

	Total Alcohol Consumption	Frequency of Typical Consumption Days	Quantity of Consumption on Typical Days	Frequency of Heavy Drinking Days	Quantity of Consumption on Heavy Days	Binge Drinking

RAPI Total	.666** .000	.612** .000	.628** .000	.585** .000	.602** .000	.449** .000

** $p < .01$

Moreover, as hypothesized, current marijuana use was positively correlated with the SIP-D total score ($r = .62$, $p < .001$) such that those reporting increased frequency of marijuana use also reported more drug use consequences. In addition, classification as a regular marijuana user was positively correlated with the SIP-D total score ($r = .56$, $p < .001$), such that those classified as regular marijuana users also reported more drug use consequences. As hypothesized (*Aim 1,* Hyp 1), current other illicit drug use also was positively correlated with consequences on the SIP-D, such that those who reported currently using other illicit drugs also reported more drug-related consequences. Specifically, current Cocaine/Crack ($r = .33$, $p < .001$), Stimulant ($r = .43$, $p < .001$), Heroin ($r = .43$, $p < .001$), and Hallucinogen ($r = .37$, $p < .001$) use over the last 90 days were all positively correlated with the SIP-D total score. Those that reported using more of these other illicit substances (Cocaine/Crack, Stimulants, Heroin, Hallucinogens) also reported experiencing more drug use negative consequences. However, when examining other drugs of abuse (e.g., sedatives, inhalants, steroids, etc.) in the last 90 days there were no significant correlations with the SIP-D.

Interestingly, ADHD stimulant medication misuse in the past year was positively correlated with total alcohol consumption, binge drinking, and the RAPI. Those that reported misusing ADHD stimulant medication reported more alcohol consumption, were more likely to be binge drinkers, and reported more alcohol-related negative consequences. In addition, ADHD stimulant medication misuse was positively correlated with overall other illicit drug use, use of non-prescribed prescriptions, and showed a trend towards the SIP-D ($r = .24$, $p = .057$). Specifically, those that reported misusing ADHD stimulant medication also reported currently using other illicit drugs and using more non-prescribed medications. These results are presented in *Table 16* below.

Table 16. ADHD Stimulant Misuse in Relation to Alcohol and Other Drug Use in last 90 days

	Total Alcohol Consumption	Binge Drinking	RAPI	Other Non-Prescribed Drug Use	Other Illicit Use
ADHD Stimulant Misuse	.328** .007	.340** .005	.455** .000	.371** .002	.431** .000

** p < .01

Aim 2: General and ADHD Predictors of Substance Use and Negative Consequences

In this section I report on the relationship of general substance use predictors and ADHD specific predictors to substance use patterns and associated negative consequences within the sample. First, the general substance use predictors (i.e., substance use history, history of conduct problems, peer influence, alcohol and marijuana expectancies, and sensation seeking traits) and their relationship to current substance use and consequences are reported. Next, the ADHD specific predictors (i.e., severity of symptoms on ASRS, impairment on T.O.V.A., impulsivity and emotion dysregulation, and executive functioning deficits) and their relationship to current substance use and consequences are reported.

Pearson zero order correlations were calculated between substance use criterion variables and all the general and ADHD specific substance use risk predictors before conducting linear and logistic regression analyses. The eight criterion variables included: total alcohol consumption, binge drinking (5 or more standard drinks in one sitting), alcohol consequences on the RAPI, current marijuana use, classification as a regular marijuana user (use at least once a week in last 90 days), drug use consequences on the SIP-D, current other illicit drug use, and misuse of ADHD stimulant medication. All regression analyses controlled for the following covariates: current age, sex, current year in college, and history of conduct problems (if the initial model was significant).

Specifically, each regression analysis was run without covariates initially to determine if the model was significant. If the model was not significant, no covariates were added. However, regression models that were significant were rerun again with previously mentioned covariates to determine if they would remain significant. Due to prior research indicating a link between a history of conduct problems and substance use/consequences, this was controlled for to examine any effect of general and/or ADHD specific factors beyond that of conduct problems.

To help clarify later regression analyses, the direction of the values of beta weights associated with how the controlling or covariate variables were coded are outlined next. In all regression analyses, POSITIVE beta-weights were associated with the following covariate values and indicated: higher current age, being female, higher current year in college, and greater history of conduct problems. NEGATIVE beta-weights associated with the covariate values indicate the following: younger current age, being male, lower current year in college, and less history of conduct problems.

Each section presents tables that include results of linear regression and those of logistic regression for the eight criterion variables previously mentioned. For clarity, in each table analyses that utilized covariates are indicated with a “#” next to the model. This is also noted beneath each table.

Next, within this section, exploratory analyses are presented that display the best regression models for each criterion substance use variable incorporating the significant general and/or ADHD specific predictors in relation to substance use patterns and associated negative consequences. In all of these models, demographics and history of conduct problems were controlled for, unless history of conduct problems was used as a predictor variable within the regression model. These results are presented in tables for both linear and logistic regression analyses.

Finally, it was hypothesized that perhaps the combination of severity of ADHD symptoms (i.e., ASRS) and current substance use might predict greater substance use negative consequences in the sample (*Aim 2*, Hyp 4). Therefore, moderation analyses are reported using the ASRS as the predictor variable, and selected substance use variables as potential moderators (i.e., current alcohol consumption, binge drinking status, current marijuana use, classification as a regular marijuana user, and Other Illicit drug use), and the RAPI and SIP-D as the criterion variables. Due to the limited findings and poor predictive power of ADHD medication misuse as related to negative substance abuse consequences, it was not included in the moderation analyses.

General Predictors of Substance Use Patterns and Consequences

Substance Use History Results. Substance use history was measured by age of first alcohol use, age of first marijuana use, and lifetime having ever used other illicit substances. It was hypothesized that individuals who began using at a younger age would report more current use, and those that used other illicit drugs in the past would be more likely to report current use of illicit substances and more consequences on the SIP-D (*Aim 2*, Hyp 1a). As hypothesized, results showed that age of first alcohol use was negatively correlated with current alcohol consumption ($r = -.79$, $p < .01$) and binge drinking ($r = -.48$, $p < .01$). Those that reported first using alcohol at younger ages also reported more current total alcohol consumption and were more likely to be binge drinkers. Further, age of first alcohol use was negatively correlated with alcohol-related negative consequences on the RAPI ($r = -.30$, $p < .05$), such that those who reported first using alcohol at younger ages also reported more current alcohol-related negative consequences.

Similarly, age of first use of marijuana was negatively correlated with current marijuana use ($r = -.44$, $p < .01$), being classified as a regular marijuana user ($r = -.35$, $p < .05$), and drug-related consequences on the SIP-D ($r = -.41$, $p < .01$). Those that reported using marijuana at a younger age also reported more current marijuana use, were more likely to be classified as a regular marijuana user and reported more current drug-related consequences. In addition, having ever used illicit substances besides marijuana and/or ADHD stimulant medications was positively correlated with current illicit substance use ($r = .23$, $p < .05$) and drug-related consequences on the SIP-D ($r = .42$, $p < .01$). Those that reported using illicit substances in the past also reported more current illicit substance use and drug-related consequences. However, contrary to the hypothesis, neither age of first alcohol use ($r = .22$, $p > .05$) nor a history of illicit substance use was correlated with current misuse of ADHD stimulant medication ($r =$

.14, $p > .05$).

Next, regression analyses were used to examine the relationship of substance use history to current substance use and consequences, controlling for demographics and history of conduct problems. Results from linear and logistic regression analyses were somewhat similar to those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, Linear regression analysis revealed that younger age of first use of alcohol, predicted higher current alcohol consumption, $r^2 = .28$ (adjusted $r^2 = .21$), F (5, 57) = 4.39, $p < .01$. In addition, logistic regression analysis of age of first use of alcohol on binge drinking status resulted in a significant model accounting for approximately 38% of the variance in the criterion (*Cox & Snell R Square* = .378, $p = .000$), with younger age of first use predicting being a current binge drinker. Contrary to the hypothesis, age of first use of alcohol did not uniquely predict alcohol-related negative consequences on the RAPI. Even though the regression model was significant, $r^2 = .23$ (adjusted $r^2 = .17$), F (5, 57) = 3.47, $p < .01$, age of first use was no longer significant after controlling for the previously mentioned variables. The variance in this model predicting RAPI score was best accounted for by a higher current year in college ($B = .433$, $t = 2.417$, $p = .019$) and a greater number of conduct problems ($B = .268$, $t = 1.995$, $p = .051$).

As expected, younger age of first use of marijuana predicted higher levels of current marijuana use, $r^2 = .29$ (adjusted $r^2 = .20$), F (5, 40) = 3.21, $p < .05$. Interestingly, logistic regression analysis revealed younger age of first use of marijuana approached significance in predicting being classified as a regular marijuana user currently (*Cox &*

Snell R Square = .205, p = .062) after controlling for age, sex, current year in college, and history of conduct problems. History of other illicit substance use significantly predicted more drug-related problems on the SIP-D, r^2 = .26 (adjusted r^2 = .19), F (5, 60) = 4.14, p < .01, however, it did not predict current other illicit use (*Cox & Snell R Square* = .122, p = .128) or misuse of ADHD stimulant medication (*Cox & Snell R Square* = .020, p = .249). *Table 17* displays detailed results of the linear regression statistics, while *Table 18* displays results of the logistic regression analyses.

Table 17. Linear Regression, Substance Use History on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor/Criterion Variables	Standardized (B)	SE	*t*	Sig
# Age of First Use / Current Alcohol Use	-.317	5.538	-2.373	p = .006*
# Age of First Use / Current Alcohol Consequences	-.172	.746	-1.254	p = .215
# Age of First Mar Use/ Current Mar Use	-.316	.277	-2.084	p = .044*
# Illicit Use History / Current Drug Consequences	.358	1.900	2.716	p = .009**

* p < .05
** p < .01
# : Controlled for age, sex, and current year in college.

Table 18. Logistic Regression, Substance Use History on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor/Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Age of First Use / Binge Drinker	-.834	.306	7.41	.435	*p* = .006**
# Age of First Mar Use / Regular Mar User	-.364	.238	2.346	.695	*p* = .126
Illicit Use History / Current Illicit Use	1.095	.827	1.755	2.990	*p* = .185
Illicit Use History / ADHD Stim Misuse	-.671	.589	1.297	.511	*p* = .255

** $p < .01$
# : Controlled for age, sex, and current year in college.

To summarize, as hypothesized, younger age of alcohol use predicted more current alcohol consumption and classification as a binge drinker; however, this was not true for alcohol-related negative consequences on the RAPI. Moreover, as hypothesized, younger age of first marijuana use predicted more current use and classification as a regular marijuana user and having a history of illicit drug use predicted more drug-related consequences on the SIP-D. Contrary to hypotheses, having a history of illicit substance use did not predict current illicit use or misuse of ADHD stimulant medication.

History of Conduct Problems Results. Having a history of a higher number of childhood conduct problems as measured by the SCID-PQ, was hypothesized to result in greater substance use and associated consequences (*Aim* 2, Hyp 1b). Correlational findings indeed showed history of conduct problems in childhood was positively correlated with current alcohol consumption ($r = .33$, $p < .01$) and binge drinking ($r = .29$, $p < .05$). Those that reported more conduct problems in childhood also reported more current alcohol consumption and were more likely to be classified as binge drinkers. Further, history of conduct problems was positively correlated with alcohol-related negative consequences on the RAPI ($r = .26$, $p < .05$), such that those who reported more conduct problems in childhood also reported more current alcohol-related consequences. Similarly, history of conduct problems was positively correlated with current marijuana use ($r = .41$, $p < .01$) and being a regular marijuana user ($r = .35$, $p < .01$), such that those who reported more conduct problems in childhood also reported more current marijuana use and were more likely to be classified as a regular marijuana user. In addition, having a history of conduct problems was positively correlated with current other illicit substance use ($r = .252$, $p < .05$) and drug-related consequences on the SIP-D ($r = .35$, $p < .01$), such that those reporting more conduct problems in childhood also reported more current illicit drug use and more drug-related consequences. However, contrary to hypothesis, history of conduct problems was not correlated with current misuse of ADHD stimulant medication ($r = .20$, $p > .05$).

Next, regression analyses were used to examine the relationship of history of conduct problems to current substance use and consequences, controlling for demographics. Results of linear and logistic regression analyses were similar to those of the correlational analyses. This remained true even when controlling for current age, sex, and current year in college, unless otherwise specified. Specifically, Linear regression analysis revealed that more reported conduct problems in childhood predicted more current alcohol consumption, $r^2 = .18$ (adjusted $r^2 = .12$), F (4, 61) = 3.25, $p < .05$. In addition, logistic regression analysis of history of conduct problems on binge drinking status resulted in a significant model accounting for approximately 19% of the variance in the criterion (*Cox & Snell R Square* = .186, $p = .009$), with more reported history of conduct problems predicting being classified as a binge drinker. Additionally, linear regression analysis results showed more reported history of conduct problems predicted more alcohol-related negative consequences on the RAPI, $r^2 = .20$ (adjusted $r^2 = .15$), F (4, 61) = 3.86, $p < .01$.

As expected, more reported history of conduct problems also predicted higher levels of current marijuana use, $r^2 = .20$ (adjusted $r^2 = .14$), F (4, 61) = 3.73, $p < .01$. Logistic regression analysis of history of conduct problems on being classified as a regular marijuana user resulted in a significant model accounting for approximately 15% of the variance in the criterion (*Cox & Snell R Square* = .148, $p = .032$), with more reported conduct problems predicting classification as a regular marijuana user. More reported conduct problems significantly predicted more drug-related problems on the SIP-D, $r^2 = .17$ (adjusted $r^2 = .11$), F (4, 61) = 3.02, $p < .05$. Interestingly, history of conduct problems originally predicted current more other illicit drug use; however, upon controlling for age, sex, and current year in college the regression equation was no longer significant (*Cox & Snell R Square* = .097, $p = .150$). Finally, logistic regression analysis revealed that history of conduct problems was not a significant predictor of misuse of ADHD stimulant medication in the regression equation (*Cox & Snell R Square* = .035, $p = .125$). *Table 19* displays detailed results of the linear regression statistics, while *Table 20* displays results of the logistic regression analyses.

Table 19. Linear Regression, History of Conduct Problems on Current Use and Consequences (If Significant: Controlling for Age, Sex, and Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig
# Current Alcohol Use	.348	4.957	2.141	$p = .036$*
# Current Alcohol Consequences	.331	.606	2.825	$p = .006$**
# Current Mar Use	.391	.186	3.330	$p = .001$**
# Current Drug Consequences	.394	.403	3.287	$p = .002$**

* $p < .05$
** $p < .01$
\# : Controlled for age, sex, and current year in college.

Table 20. Logistic Regression, History of Conduct Problems on Current Use and Consequences (If Significant: Controlling for Age, Sex, and Current Year in College).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Binge Drinker	.411	.189	4.719	1.508	$p = .030$*
# Regular Mar User	.343	.144	5.719	1.410	$p = .017$*
# Current Illicit Use	.303	.144	4.436	1.354	$p = .035$
ADHD Stim Misuse	.195	.127	2.362	.823	$p = .124$

* $p < .05$
\# : Controlled for age, sex, and current year in college.
Note: Some of the individual statistics in the table will be displayed as significant, even if the regression model was not significant as discussed above. For ease of interpretation these will not be notated with an asterisk. Only significant statistics that the regression model was significant for will be notated with an asterisk.

To summarize, in general, history of conduct problems was a good predictor of substance use patterns and associated negative consequences in this sample. As hypothesized, more reported conduct problems in childhood predicted more current alcohol consumption, classification as a binge drinker, and more alcohol-related negative consequences. Moreover, more reported conduct problems in childhood predicted more current marijuana use and classification as a regular marijuana user, and more drug-related consequences. However, similar to substance use history, and contrary to hypotheses, history of conduct problems did not predict other current illicit drug use or misuse of ADHD stimulant medication.

Peer Influence Results. Perceptions of peer substance use as normative (i.e., peer influence), assessed by the 9-item measure adapted from Van Eck et al. (2014) study, was also hypothesized to be associated with greater substance use and negative consequences (*Aim* 2, Hyp 1c). Correlational results showed peer influence was positively correlated with current alcohol consumption ($r = .43$, $p < .01$) and binge drinking ($r = .37$, $p < .01$), such that those who reported higher peer influence also reported more alcohol consumption and were more likely to be classified as a binge drinker. Further, peer influence was positively correlated with alcohol-related negative consequences on the RAPI ($r = .27$, $p < .05$), such that those who reported higher peer influence also reported more alcohol consequences on the RAPI. However, contrary to hypotheses (*Aim* 2, Hyp 1c) peer influence was not significantly correlated with current marijuana use ($r = .20$, $p > .05$) or being classified as a regular marijuana user ($r = .18$, $p > .05$). Moreover, peer influence was not correlated with current other illicit substance use ($r = .10$, $p > .05$), drug-related consequences on the SIP-D ($r = .17$, $p > .05$), or current misuse of ADHD stimulant medication ($r = .10$, $p > .05$).

Next, regression analyses were used to examine the relationship of peer influence to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses were similar to those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and conduct disorder unless otherwise specified. Specifically, Linear regression analysis revealed that higher levels of reported peer influence on substance use predicted more current alcohol consumption, $r^2 = .30$ (adjusted $r^2 = .24$), F (5, 60) = 5.042, $p < .01$. In addition, logistic regression analysis of peer influence on binge drinking status resulted in a significant model accounting for approximately 28% of the variance in the criterion (*Cox & Snell R Square* = .277, p = .001), with those who reported higher levels of peer influence also being classified more often as binge drinkers. In addition, linear regression analysis results showed peer influence predicted more alcohol-related negative consequences on the RAPI, $r^2 = .25$ (adjusted $r^2 = .19$), F (5, 60) = 3.99, $p < .05$; however, upon further examination it only approached significance as an individual predictor after controlling variables were added to the model. It is likely better accounted for by the control variables history of conduct problems ($B = .290$, $t = 2.493$, $p = .015$) and higher year in college ($B = .452$, $t = 2.626$, $p = .011$).

Contrary to our hypothesis (*Aim* 2, Hyp 1c), peer influence did not predict higher levels of current marijuana use, $r^2 = .09$ (adjusted $r^2 = .03$), F (4, 61) = 1.41, $p > .05$ or being classified as a regular marijuana user (*Cox & Snell R Square* = .084, $p = .216$). Similarly, peer influence did not predict drug-related problems on the SIP-D, $r^2 = .03$ (adjusted $r^2 = .01$), F (1, 64) = 1.94, $p > .05$, current other illicit drug use, (*Cox & Snell R*

Square = .010, *p* = .406), or misuse of ADHD stimulant medication (*Cox & Snell R Square* = .010, *p* = .425). *Table 21* displays detailed results of the linear regression statistics, while *Table 22* displays results of the logistic regression analyses.

Table 21. Linear Regression, Peer influence on Current Use and Consequences (If Significant: Controlling for Age, Sex, and Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig
# Current Alcohol Use	.356	1.180	3.198	*p* = .002**
# Current Alcohol Consequences	.224	.151	1.952	*p* = .056
Current Mar Use	.187	.050	1.509	*p* = .136
Current Drug Consequences	.171	.015	1.392	*p* = .169

** p < .01
# : Controlled for age, sex, and current year in college.

Table 22. Logistic Regression, Peer Influence on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Binge Drinker	.117	.048	6.005	1.124	*p* = .014*
Regular Mar User	.045	.033	1.823	1.046	*p* = .177
Current Illicit Use	.030	.037	.690	1.031	*p* = .406
ADHD Stim Misuse	-.027	.034	.636	.973	*p* = .425

* p < .05
# : Controlled for age, sex, and current year in college.

In summary, peer influence was not a consistent predictor of substance use patterns and negative consequences in this sample. In fact, peer influence (or perceived norms regarding peer use) only predicted current alcohol consumption and classification as a binge drinker. Specifically, higher perceptions of peer use predicted more current alcohol consumption and being classified as a binge drinker. Surprisingly, it did not predict alcohol-related negative consequences in this sample or use of other drugs or associated consequences.

Positive Substance Use Expectancies Results. Positive substance use expectancies were assessed by the R-AEQ (positive alcohol expectancies) and the MEQ (positive marijuana expectancies). The hypothesis (*Aim* 2, Hyp 1d) was that higher scores on alcohol expectancies would relate to increased alcohol use and negative consequences. Similarly, it was expected that higher scores on the MEQ would relate to increased marijuana and other drug use as well as drug-related consequences. As hypothesized, results showed positive alcohol expectancies were positively correlated with current alcohol consumption ($r = .45$, $p < .01$) and binge drinking ($r = .36$, $p < .01$), such that those who reported higher alcohol expectancies also reported more current alcohol use and were more often classified as a binge drinker. Further, positive alcohol expectancies were positively correlated with alcohol-related negative consequences on the RAPI ($r = .38$, $p < .01$), such that those who reported higher alcohol expectancies also reported more alcohol-related negative consequences.

Similarly, positive marijuana expectancies were positively correlated with current marijuana use ($r = .70$, $p < .01$) and being classified as a regular marijuana user ($r = .64$,

$p < .01$). Those that reported higher marijuana expectancies also reported currently using more marijuana and were more likely to be classified as a regular marijuana user. Moreover, positive marijuana expectancies were also positively correlated with current other illicit substance use ($r = .39$, $p < .01$) and drug-related consequences on the SIP-D ($r = .57$, $p < .01$). Those that reported higher marijuana expectancies also reported more current other illicit drug use and more drug-related negative consequences. As hypothesized, positive marijuana expectancies were positively correlated with current misuse of ADHD stimulant medication ($r = .33$, $p < .05$), such that, those who reported higher marijuana expectancies also reported misuse of ADHD stimulant medication in the last year.

Next, regression analyses were used to examine the relationship of positive alcohol and marijuana expectancies to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses were similar to those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and conduct disorder unless otherwise specified. Specifically, Linear regression analysis revealed that higher levels of reported positive alcohol expectancies predicted more current alcohol consumption, $r^2 = .31$ (adjusted $r^2 = .25$), F (5, 60) = 5.35, $p < .01$. In addition, logistic regression analysis of positive alcohol expectancies on binge drinking status resulted in a significant model accounting for approximately 29% of the variance in the criterion (*Cox & Snell R Square* = .287, $p = .000$), with higher alcohol expectancies predicting classification as a binge drinker. In addition, linear regression analysis results showed positive alcohol expectancies predicted more alcohol-related negative consequences on the RAPI, $r^2 = .32$ (adjusted $r^2 = .26$), F (5, 60) = 5.67, $p <$ .01).

Similarly, positive marijuana expectancies predicted higher levels of current marijuana use, $r^2 = .53$ (adjusted $r^2 = .49$), F (5, 60) = 13.37, $p < .01$. Moreover, logistic regression analysis of positive marijuana expectancies on being classified as a regular marijuana user resulted in a significant model accounting for approximately 43% of the variance in the criterion *Cox & Snell R Square* = .425, $p = .000$), with higher marijuana expectancies predicting classification as a regular marijuana user. Further, positive marijuana expectancies predicted more drug-related problems on the SIP-D, $r^2 = .38$ (adjusted $r^2 = .33$), F (5, 60) = 7.31, $p < .01$. Logistic regression analysis of positive marijuana expectancies on other illicit drug use resulted in a significant model accounting for approximately 20% of the variance in the criterion *Cox & Snell R Square* = .203, $p = .010$), with higher marijuana expectancies predicting more current other illicit drug use. Finally, Logistic regression analysis of positive marijuana expectancies on misuse of ADHD stimulant medication resulted in a significant model but only accounted for approximately 4.0% of the variance in the criterion (*Cox & Snell R Square* = .010, $p =$ .425), with higher marijuana expectancies predicting misuse of ADHD stimulant medication. *Table 23* displays detailed results of the linear regression statistics, while *Table 24* displays results of the logistic regression analyses.

Table 23. Linear Regression, Positive Alcohol and Marijuana Expectancies on Current Use and Consequences (If Significant: Controlling for Age, Sex, and Current Year in College).

Predictor / Criterion Variables	Standardized (B)	SE	*t*	Sig
# Alcohol Exp / Current Alcohol Use	.391	1.334	3.388	*p* = .001*
# Alcohol Exp / Current Alcohol Consequences	.371	.164	3.239	*p* = .002*
# Mar Exp / Current Mar Use	.626	.014	6.472	*p* = .000**
# Mar / Current Drug Consequences	.503	.034	4.450	*p* = .000**

* p < .05
** p < .001
# : Controlled for age, sex, and current year in college.

Table 24. Logistic Regression, Positive Alcohol and Marijuana Expectancies on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor / Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Alcohol Exp / Binge Drinker	.128	.047	7.552	1.137	*p* = .006**
# Mar Exp / Regular Mar User	.085	.023	13.855	1.089	*p* = .000**
# Mar Exp / Current Illicit Use	.050	.020	6.128	1.051	*p* = .013*
# Mar Exp / ADHD Stim Misuse	.042	.015	7.294	.959	*p* = .007**

* p < .05
* p < .001

In summary, positive alcohol and marijuana expectancies were excellent predictors of substance use patterns and associated negative consequences in this sample. Specifically, higher positive alcohol expectancies predicted more current alcohol use, classification as a binge drinker, and more alcohol-related negative consequences. Moreover, higher marijuana expectancies predicted more current marijuana use, classification a regular marijuana user, more drug-related problems, current illicit drug use, and current misuse of ADHD stimulant medication.

Sensation Seeking Results. Sensation seeking personality characteristics were assessed by the SSS – Thrill and Adventure Seeking Subscale. Of note, these findings should be interpreted with caution due to the low internal consistency of this measure (Cronbach's Alpha = .15) in our sample. The correlational findings did not support the hypotheses (*Aim* 2, Hyp 1e). There was no correlation between sensation seeking and current alcohol consumption (r = -.18, p > .05). There was a significant negative correlation between sensation seeking and binge drinking status (r = -.28, p < .05) and alcohol-related negative consequences on the RAPI (-.29, p > .05). Those that reported higher sensation seeking also were not classified as binge drinkers and reported lower alcohol-related negative consequences. These correlations were in the opposite direction than hypothesized.

Similarly, contrary to the hypotheses (*Aim* 2, Hyp 1e) sensation seeking was not correlated with current marijuana use (r = -.19, p > .05) or being classified as a regular marijuana user (r = -.21, p > .05). Interestingly, sensation seeking was again negatively correlated with current other illicit substance use (r = -.25, p < .05) and with drug-related consequences on the SIP-D (r = -.29, p < .05). Those who reported higher sensation seeking also reported less current other illicit use and less drug-related negative consequences. These correlations were opposite of the expected direction. Finally, sensation seeking was not correlated with current misuse of ADHD stimulant medication (r = .20, p > .05).

Next, regression analyses were used to examine the relationship of sensation seeking to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses were generally similar to those of the correlational analyses, and did not support the hypotheses (*Aim 2*, Hyp 1e). This remained true even when controlling for current age, sex, current year in college, and conduct disorder unless otherwise specified. Specifically, Linear regression analysis revealed that sensation seeking did not predict current alcohol consumption, $r^2 = .03$ (adjusted $r^2 = .02$), $F(1, 64) = 2.04$, $p > .05$. Interestingly, logistic regression analysis of sensation seeking on binge drinking status resulted in a significant model accounting for approximately 26% of the variance in the criterion (*Cox & Snell R Square* = .257, $p = .001$), with results indicating that higher levels of sensation seeking predicted not being classified as a binge drinker. Moreover, linear regression analysis results showed higher sensation seeking predicted less alcohol-related negative consequences on the RAPI, $r^2 = .31$ (adjusted $r^2 = .25$), $F(5, 60) = 5.36$, $p > .01$, in the opposite direction as hypothesized.

Contrary to the hypotheses, sensation seeking did not predict higher levels of current marijuana use, $r^2 = .04$ (adjusted $r^2 = .02$), $F(1, 64) = 2.35$, $p > .05$ or being classified as a regular marijuana user (*Cox & Snell R Square* = .042, $p = .092$). Interestingly, higher sensation seeking predicted less drug-related problems on the SIP-D, $r^2 = .26$ (adjusted $r^2 = .20$), $F(5, 60) = 4.16$, $p < .05$ and less current other illicit drug use; however, this difference was no longer significant in a regression model after controlling for age, sex, current year in college, and history of conduct problems, (*Cox & Snell R Square* = .147, $p = .062$). Finally, sensation seeking did not predict misuse of

ADHD stimulant medication (*Cox & Snell R Square* = .039, *p* = .104). *Table 25* displays detailed results of the linear regression statistics, while *Table 26* displays results of the logistic regression analyses.

Table 25. Linear Regression, Sensation Seeking on Current Use and Consequences (If Significant: Controlling for Age, Sex, and Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	-.176	7.241	-1.430	*p* = .158
# Current Alcohol Consequences	-.346	.831	-3.041	*p* = .003**
Current Mar Use	-.188	.274	-1.532	*p* = .130
# Current Drug Consequences	-.322	.560	-2.734	*p* = .008**

** p < .01
# : Controlled for age, sex, and current year in college.

Table 26. Logistic Regression, Sensation Seeking on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Binge Drinker	-.573	.251	5.203	.564	*p* = .023*
Regular Mar User	-.290	.177	2.676	.748	*p* = .102
Current Illicit Use	-.438	.240	3.330	.646	*p* = .068
ADHD Stim Misuse	-.311	.195	2.536	1.364	*p* = .111

* p < .05
# : Controlled for age, sex, and current year in college.

In summary, results of sensation seeking as a general predictor of current substance use patterns and associated negative consequences in this sample were poor. Overall, sensation seeking was not a good predictor of the majority of the criterion variables and when there was a significant prediction it was in the opposite direction than hypothesized (i.e., binge drinking, alcohol consequences, drug use consequences). Importantly, these findings are completely inconsistent from those of prior studies using the same measure with college students. However, no studies have used this measure with only ADHD college students. Moreover, due to the poor reliability of this measure (Cronbach's Alpha = .15), it cannot be determined whether or not this measure was actually assessing the construct of sensation seeking in this sample. Therefore, the sensation seeking measure was excluded from all further analyses.

General Substance Predictors

Overall, general substance predictors were demonstrated to have predictive value in this ADHD sample in that they were associated with substance use patterns and associated negative consequences. Substance use history predicted all the substance criterion variables except for current other illicit use and misuse of ADHD stimulant medication. Similarly, history of conduct problems predicted all the substance criterion variables except for current other illicit use and misuse of ADHD stimulant medication. The results of peer influence as a general substance predictor were less consistent, in that it only predicted current alcohol consumption and classification as a binge drinker. However, positive alcohol and marijuana expectancies emerged as excellent predictors, in that they predicted all the substance criterion variables in the expected direction. Surprisingly, sensation seeking as a general predictor was poor in this sample, most likely due to reliability issues previously mentioned.

Aim 2: ADHD Specific Predictors and Current Substance Use/Consequences

In this section of *Aim 2*, the ADHD specific predictors (i.e., severity of symptoms on ASRS, impairment on the T.O.V.A., impulsivity and emotion dysregulation, and executive functioning deficits) and their relationship to current substance use and consequences are reported. Pearson correlations were calculated between substance use criterion variables and all of the ADHD specific substance use risk predictors before conducting linear and logistic regression analyses. The eight criterion variables again included: total alcohol consumption, binge drinking (5 or more standard drinks in one sitting), alcohol consequences on the RAPI, current marijuana use, classification as a regular marijuana user (use at least once a week in last 90 days), drug use consequences on the SIP-D, current other illicit drug use, and misuse of ADHD stimulant medication. Each section presents tables that include results of linear regression and those of logistic regression for the eight criterion variables previously mentioned.

Severity of ADHD Symptoms on the ASRS. ADHD symptom severity was measured using the ASRS total score. The hypothesis (*Aim* 2, Hyp 2a) was that higher scores on the ASRS (i.e., greater symptom severity) would relate to increased substance use and negative consequences. Contrary to the hypothesis, results showed no significant correlation between the ASRS total score and current alcohol use (r = -.03, p > .05), binge drinking (r = .05, p > .05), or alcohol-related negative consequences on the RAPI (r = .12, p > .05). Similarly, the ASRS was not correlated with current marijuana use (*r* = .12, *p* > .05), or being classified as a regular marijuana user (*r* = .14, *p* > .05). However, as hypothesized, severity of symptoms on the ASRS was positively correlated with drug-related consequences on the SIP-D (*r* = .31, *p* < .05), such that those reporting greater ADHD symptom severity also reported more drug-related negative consequences. Finally, contrary to our hypothesis, there was no correlation between the ASRS and current illicit substance use (*r* = .10, *p* > .05), as well as current misuse of ADHD stimulant medication (*r* = -.03, *p* > .05).

Next, regression analyses were used to examine the relationship of severity of ADHD symptoms on the ASRS to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses mirrored those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, contrary to our hypothesis (*Aim* 2, Hyp 2a), linear regression analysis revealed that self-reported severity of ADHD symptoms on the ASRS did not predict current alcohol consumption, r^2 = .001 (adjusted r^2 = -.02), *F* (1, 64) = .047, *p* > .05. Logistic regression analysis of the ASRS on binge drinking status did not result in a significant model (*Cox & Snell R Square* = .002, *p* = .717). Moreover, linear regression analysis revealed that the ASRS did not predict alcohol-related consequences on the RAPI, r^2 = .02 (adjusted r^2 = .000), *F* (1, 64) = .972, *p* > .05, or current marijuana use, r^2 = .01 (adjusted r^2 = -.002), *F* (1, 64) = .358, *p* > .05. Similarly, logistic regression analysis of the ASRS on classification as a regular marijuana user did not result in a significant model (*Cox & Snell R Square* = .019, *p* = .262).

Interestingly, as hypothesized, higher ASRS total scores significantly predicted more drug-related problems on the SIP-D; r^2 = .21 (adjusted r^2 = .15), F (5, 60) = 3.20, p < .05. However, after controlling for age, sex, current year in college, and history of conduct problems the ASRS as a predictor only approached significance (p = .068), with history of conduct problems (B = .327, t = 2.663, p = .010), accounting for majority of the variance. Finally, the ASRS did not predict current other illicit use (*Cox & Snell R Square* = .009, p = .437) or misuse of ADHD stimulant medication (*Cox & Snell R Square* = .001, p = .823). *Table 27* displays detailed results of the linear regression statistics, while *Table* 28 displays the results of the logistic regression statistics.

Table 27. Linear Regression, ASRS on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	-.027	.947	-.216	p = .830
Current Alcohol Consequences	.122	.117	.986	p = .328
Current Marijuana Use	.115	.036	.925	p = .358
# Current Drug Consequences	.243	.080	1.856	p = .068

: Controlled for age, sex, and current year in college.

Table 28. Logistic Regression, ASRS on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	.008	.022	.131	1.008	p = .717

Regular Mar User	.025	.022	1.281	1.025	$p = .270$
Current Illicit Use	.021	.027	.594	1.021	$p = .111$
ADHD Stim Misuse	-.005	.024	.050	1.005	$p = .823$

In summary, severity of ADHD symptoms on the ASRS was a poor predictor of substance use patterns and associated negative consequences in this sample. There were no substance use or consequence criterion variables that were associated with ASRS symptoms or successfully predicted by the ASRS. Although, the ASRS significantly predicted drug-use negative consequences on the SIP-D, this was no longer significant after controlling variables were added. Specifically, conduct disorder accounted for most of the variance in the regression model.

Performance on the T.O.V.A. The T.O.V.A. is a Continuous Performance Test (CPT) that calculates response time variability (consistency), response time (speed), commissions (impulsivity), and omissions (focus and vigilance) and compares these to a normative sample. The T.O.V.A. was used as a behavioral performance task of attention difficulties or impairment in this sample. Standard Scores were used for all analyses of the T.O.V.A. and can be interpreted as follows: Scores above 110 are above average, scores between 85 – 110 are average, scores between 80 – 85 are borderline, scores below 80 are not within normal limits. T.O.V.A. overall Reaction Time Variability (RTV), overall Response Time (RT), overall Commission Errors (CE) and overall Omission Errors (OE) were calculated using standard scores. When interpreting higher scores on all of the T.O.V.A. variables, higher scores would indicate better performance, while lower scores would indicate greater impairment in attention.

The hypothesis (*Aim* 2, Hyp 2b), was that lower standard scores on the T.O.V.A. RTV, RT, CE, and OE would relate to more substance use and associated consequences. Contrary to this hypothesis, correlational findings indicated no significant correlations between the T.O.V.A. RTV, RT, CE, and OE and current alcohol use (r = .01, p > .05; r = -.01, p > .05; r = -.01, p > .05; r = -.18, p > .05), respectively. Interestingly, T.O.V.A. RTV, RT, and CE also were not correlated with binge drinking status (r = -.03, p > .05; r = -.04, p > .05; r = -.16, p > .0), respectively; however, T.O.V.A. OE was negatively correlated with binge drinking (r = -.29, p < .05) as expected. Those with more omission errors (difficulties with focus and vigilance) on the T.O.V.A were more likely to be classified as binge drinkers. In addition, T.O.V.A. variables (i.e. RTV, RT, CE, and OE) were not correlated with alcohol-related negative consequences on the RAPI (r = .02 p > .05; r = -.01, p > .05; r = -.05, p > .05; r = -.05, p > .05), respectively.

Similarly, T.O.V.A. scores (i.e. RTV, RT, CE, and OE) were also not correlated with current marijuana use (r = -.01 p > .05; r = .05, p > .05; r = -.09, p > .05; r = -.13, p > .05), respectively, or being classified as a regular marijuana user (r = -.02 p > .05; r = .06, p > .05; r = -.12, p > .05; r = -.12, p > .05), respectively. Moreover, the T.O.V.A. variables RTV, RT, CE, and OE were not correlated with drug-related consequences on the SIP-D (r = .08 p > .05; r = .09, p > .05; r = -.17, p > .05; r = -.03, p > .05), respectively, or current misuse of ADHD stimulant medication (r = -.03 p > .05; r = -.04, p > .05; r = -.09, p > .05; r = .001, p > .05), respectively. However, one aspect of hypothesis (*Aim* 2, Hyp 2b) was partially supported. Specifically, T.O.V.A. RT and CE were significantly correlated with current Other illicit drug use (r = .29, p < .05; r = -.26, p

$< .05$), respectively. Contrary to the expected direction, those with faster response times reported more current Other illicit drug use. As expected, those with more commission errors (i.e., impulsivity) also reported more current other illicit drug use. T.O.V.A. RTV and OE were not significantly correlated with current Other illicit drug use ($r = .15$, $p > .05$; $r = -.03$, $p > .05$).

Next, regression analyses were used to examine the relationship of ADHD impairment on the T.O.V.A. to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses mirrored those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, contrary to the hypotheses (*Aim* 2, Hyp 2b), linear regression analyses revealed that T.O.V.A. RTV, RT, CE, and OE did not predict current alcohol consumption, $r^2 = .004$ (adjusted $r^2 = -.01$), F (1, 64) = .254, $p > .05$; $r^2 = .000$ (adjusted $r^2 = -.02$), F (1, 64) = .005, $p > .05$; $r^2 = .000$ (adjusted $r^2 = -.02$), F (1, 64) = .006, $p > .05$; $r^2 = .03$ (adjusted $r^2 = .02$), F (1, 64) = 2.25, $p > .05$; respectively. Similarly, logistic regression analysis of T.O.V.A. RTV, RT, and CE on binge drinking status did not result in any significant models (*Cox & Snell R Square* = .001, $p = .780$), (*Cox & Snell R Square* = .002, $p = .719$), (*Cox & Snell R Square* = .026, $p = .191$), respectively. Interestingly, a logistic regression model of T.O.V.A. OE predicting binge drinking status was significant, accounting for approximately 24% of the variance in the criterion (*Cox & Snell R Square* = .243, $p = .003$), with those who had more omission errors (focus and vigilance) also being more likely to be classified as a binge drinker. However, upon further examination, T.O.V.A. OE was no longer significant ($p = .065$)

after controlling for age, sex, current year in college, and history of conduct problems. Specifically, sex emerged as a significant covariate (*B* = -1.259, *p* = .051), with males being more likely to be classified as binge drinkers compared to females. Further, linear regression analysis revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) did not predict alcohol-related consequences on the RAPI, r^2 = .000 (adjusted r^2 = -.02), *F* (1, 64) = .03, *p* > .05 ; r^2 = .000 (adjusted r^2 = -.02), *F* (1, 64) = .007, *p* > .05; r^2 = .003 (adjusted r^2 = -.01), *F* (1, 64) = .18, *p* > .05; r^2 = .002 (adjusted r^2 = -.01), *F* (1, 64) = .13, *p* > .05; respectively.

In terms of marijuana use, the results from TOVA analyses also did not support the hypothesis (*Aim 2*, Hyp 2b). Specifically, linear regression results revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) did not predict current marijuana use, r^2 = .000 (adjusted r^2 = -.02), *F* (1, 64) = .004, *p* > .05 ; r^2 = .002 (adjusted r^2 = -.01), *F* (1, 64) = .113, *p* > .05; r^2 = .01 (adjusted r^2 = -.01), *F* (1, 64) = .48, *p* > .05; r^2 = .02 (adjusted r^2 = .002), *F* (1, 64) = 1.14, *p* > .05; respectively. Similarly, logistic regression analysis of the T.O.V.A. variables (i.e. RTV, RT, CE, and OE) on classification as a regular marijuana user did not result in any significant models (*Cox & Snell R Square* = .000, *p* = .897); (*Cox & Snell R Square* = .004, *p* = .610); (*Cox & Snell R Square* = .015, *p* = .319); (*Cox & Snell R Square* = .014, *p* = .331), respectively.

In terms of other drug use and consequences, findings were mixed and only partially supported the hypotheses. Specifically, linear regression results revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) again did not predict drug use negative consequences on the SIP-D, r^2 = .01 (adjusted r^2 = -.01), *F* (1, 64) = .38, *p* > .05 ; r^2 = .01 (adjusted r^2 = -.01), *F* (1, 64) = .54, *p* > .05; r^2 = .03 (adjusted r^2 = .01), *F* (1, 64) =

1.80, $p > .05$; $r^2 = .001$ (adjusted $r^2 = -.02$), F (1, 64) = .06, $p > .05$; respectively. Interestingly, logistic regression analyses of T.O.V.A. RTV and OE on current other illicit drug use did not result in any significant models (*Cox & Snell R Square* = .024, p = .201); (*Cox & Snell R Square* = .001, p = .814), respectively. However, T.O.V.A. RT on current Other illicit drug use resulted in a significant model accounting for approximately 20% of the variance (*Cox & Snell R Square* = .199, p = .012), such that those with faster RT used more current other illicit drugs. However, this was in the opposite direction than expected. Moreover, T.O.V.A. CE on current Other illicit drug use also resulted in a significant model accounting for approximately 20% of the variance (*Cox & Snell R Square* = .164, p = .260), with those had more commission errors, reporting more current other illicit drug use, as expected. Lastly, T.O.V.A. RTV, RT, CE, and OE on misuse of ADHD stimulant medication did not result in any significant models (*Cox & Snell R Square* = .001, p = .793); (*Cox & Snell R Square* = .002, p = .721); (*Cox & Snell R Square* = .007, p = .492); (*Cox & Snell R Square* = .000, p = .993), respectively.

In order to further test if any of the T.O.V.A. variables would significantly predict substance use and negative consequences, the TOVA variables (i.e., RTV, RT, CE, and OE) were also dichotomized into those scores that were within normal limits versus those that fell outside normal limits for age and sex. Using these variables in linear and logistic regression results completely mirrored the results of using the T.O.V.A. standard scores. Therefore, standard scores are reported throughout.

Table 29 displays results of linear regression analyses, while *Table 30* displays results of logistic regression analyses, with the T.O.V.A. RTV as the predictor variable. *Tables 31* and *32* display results of linear and logistic regression analyses with the

T.O.V.A. RT as the predictor variable, respectively. *Tables 33* and *34* display results of linear and logistic regression analyses with the T.O.V.A. CE as the predictor variable, respectively. Finally, *Tables 35* and *36* display results of linear and logistic regression analyses with the T.O.V.A. OE as the predictor variable, respectively.

Table 29. Linear Regression, T.O.V.A. RTV on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	.063	.511	.504	*p* = .616
Current Alcohol Consequences	.022	.064	.172	*p* = .864
Current Marijuana Use	-.008	.019	-.064	*p* = .949
Current Drug Consequences	.077	.041	.614	*p* = .541

Table 30. Logistic Regression, T.O.V.A. RTV on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	-.003	.012	.078	.997	*p* = .780
Regular Mar User	-.002	.012	.017	.998	*p* = .897
Current Illicit Use	.020	.016	1.464	1.020	*p* = .226
ADHD Stim Misuse	-.003	.013	.070	1.003	*p* = .792

Table 31. Linear Regression, T.O.V.A. RT on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	-.009	.577	-.068	*p* = .946
Current Alcohol Consequences	-.010	.072	-.081	*p* = .936
Current Marijuana Use	.045	.022	.364	*p* = .717
Current Drug Consequences	.092	.046	.736	*p* = .465

Table 32. Logistic Regression, T.O.V.A. RT on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	-.005	.014	.128	.995	*p* = .721
Regular Mar User	.007	.014	.255	1.007	*p* = .614
# Current Illicit Use	.071	.032	4.861	1.074	*p* = .027*
ADHD Stim Misuse	-.005	.015	.129	1.005	*p* = .719

* $p < .05$
# : Controlled for age, sex, and current year in college.

Table 33. Linear Regression, T.O.V.A. CE on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig

Current Alcohol Use	-.010	.577	-.079	*p* = .938
Current Alcohol Consequences	-.053	.072	-.428	*p* = .670
Current Marijuana Use	-.087	.022	-.695	*p* = .489
Current Drug Consequences	-.165	.046	-1.342	*p* = .184

Table 34. Logistic Regression, T.O.V.A. CE on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	-.019	.015	1.570	.982	*p* = .210
Regular Mar User	-.013	.013	.989	.987	*p* = .320
# Current Illicit Use	-.038	.018	4.617	.963	*p* = .032*
ADHD Stim Misuse	-.010	.014	.480	1.010	*p* = .488

* *p* < .05
\# : Controlled for age, sex, and current year in college.

Table 35. Linear Regression, T.O.V.A. OE on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	-.184	.501	-1.499	*p* = .139
Current Alcohol Consequences	-.045	.063	-.359	*p* = .721
Current Marijuana Use	-.132	.019	-1.068	*p* = .290
Current Drug Consequences	-.030	.041	-.240	*p* = .811

Table 36. Logistic Regression, T.O.V.A. OE on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
# Binge Drinker	-.039	.021	3.393	.962	*p* = .065
Regular Mar User	-.011	.011	.948	.989	*p* = .330
Current Illicit Use	-.003	.014	.057	.997	*p* = .812
ADHD Stim Misuse	.000	.013	.000	1.000	*p* = .993

: Controlled for age, sex, and current year in college.

In summary, various analyses in which T.O.V.A scores were used to predict substance use or substance use consequences resulted in minimal findings within this sample. Participants with more commission errors (CE) on the T.O.V.A. were more likely to be current Other illicit drug users. In one case, findings were in the opposite direction as hypothesized. Specifically, participants with faster overall response times (RT) were more likely to be current Other illicit drug users. Overall, in this sample of all ADHD college students, the T.O.V.A. variables were not good predictors of substance use patterns and negative consequences.

Impulsivity and Emotion Dysregulation on the SUPPS-P. Impulsivity and Emotion Dysregulation were measured by positive and negative urgency on the SUPPS-P, which were both expected to be related to substance abuse variables. Specifically, it was hypothesized that higher scores on the positive urgency scale (greater impulsivity) and negative urgency scale (greater emotion dysregulation) would relate to more substance use and associated negative consequences. The internal consistency for the positive urgency scale was only moderate (just .79), which again may be a factor in interpretation. Contrary to the hypothesis (*Aim* 2, Hyp 2c), Correlational findings indicated no significant correlations between positive urgency total score and current alcohol use (r = .01, p > .05), binge drinking (r = .12, p > .05), or alcohol-related negative consequences on the RAPI (r = .17, p > .05). Similarly, positive urgency was not correlated with current marijuana use (r = .07, p > .05), or being classified as a regular marijuana user (r = .000, p > .05). As hypothesized, positive urgency was positively correlated with drug-related consequences on the SIP-D (r = .33, p < .05), such that those who reported higher positive urgency scores also reported more drug-related consequences on the SIP-D. Additionally, there was not a significant correlation between positive urgency and current other illicit substance use (r = .20, p > .05) and current misuse of ADHD stimulant medication (r = .225, p > .05).

Next, regression analyses were used to examine the relationship of positive urgency (impulsivity) to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses with positive urgency as the predictor were very similar to those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, contrary to the hypothesis (*Aim* 2, Hyp 2c), linear regression analysis revealed that positive urgency did not predict current alcohol consumption, r^2 = .000 (adjusted r^2 = .02), F (1, 64) = .01, p > .05. Logistic regression analysis of positive urgency on binge drinking status did not result in a significant model (*Cox & Snell R Square* = .017, p = .287). Moreover, linear regression analysis revealed that positive urgency did not predict alcohol-related consequences on the RAPI, r^2 = .03 (adjusted r^2 = .01), *F* (1, 64) = 1.87, *p* > .05, or current marijuana use, r^2 = .004 (adjusted r^2 = .01), *F* (1, 64) = .272, *p* > .05. Similarly, logistic regression analysis of positive urgency on classification as a regular marijuana user did not result in a significant model (*Cox & Snell R Square* = .000, *p* = 1.00). However, as hypothesized, higher positive urgency total scores significantly predicted more drug-related problems on the SIP-D; r^2 = .24 (adjusted r^2 = .18), *F* (5, 60) = 3.82, *p* < .05. In addition, positive urgency did not predict current Other illicit drug use (*Cox & Snell R Square* = .036, *p* = .118).

Finally, logistic regression results revealed that a model with positive urgency as the predictor variable with misuse of ADHD stimulant medication as the criterion variable was significant, accounting for approximately 16% of the variance (*Cox & Snell R Square* = .157, *p* = .047). However, after controlling for age, sex, current year in college, and history of conduct problems, positive urgency no longer emerged as a significant predictor. Higher year in college emerged as a significant covariate that accounted for the majority of the variance in the model (*B* = 1.767, *p* = .025). *Table 37* displays detailed results of the linear regression statistics, while *Table 38* displays logistic regression results.

Table 37. Linear Regression, Positive Urgency on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	.012	3.946	-.097	*p* = .923

Current Alcohol Consequences	.169	.438	-1.368	*p* = .176
Current Marijuana Use	.065	.149	-.522	*p* = .604
# Current Drug Consequences	.282	.293	-2.454	*p* = .017*

***** $p < .05$
# : Controlled for age, sex, and current year in college.

Table 38. Logistic Regression, Positive Urgency on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	.100	.096	1.089	.905	*p* = .297
Regular Mar User	.000	.091	.000	1.000	*p* = 1.000
Current Illicit Use	.168	.108	2.409	.845	*p* = .121
# ADHD Stim Misuse	.180	.119	2.272	1.197	*p* = .132

: Controlled for age, sex, and current year in college.

In summary, various analyses in which higher urgency or impulsivity scores were used to predict substance use or substance use consequences resulted in minimal findings within this sample. In fact, there was only one case where the results were significant. Specifically, participants who reported higher levels of impulsivity, reported more drug use consequences on the SIP-D. Overall, in this sample of all ADHD college students, positive urgency (impulsivity) was not a good predictor of substance use patterns; however, it proved somewhat useful in predicting drug use consequences.

In terms of emotion dysregulation (i.e., negative urgency on the SUPPS-P) internal consistency for the scale was 84. Again, however, contrary to our hypothesis

(*Aim* 2, Hyp 2c), the findings revealed no significant correlations between negative urgency total score and current alcohol consumption (r = .07, p > .05) or binge drinking (r = .04, p > .05). There was a significant positive correlation between negative urgency and alcohol-related negative consequences on the RAPI (r = .25, p < .05), such that those who reported more negative urgency also reported more alcohol-related negative consequences. In addition, negative urgency was not correlated with current marijuana use (r = -.05, p > .05), or being classified as a regular marijuana user (r = -.09, p > .05). Moreover, negative urgency was not correlated with drug-related consequences on the SIP-D (r = .17, p > .05). Additionally, there was no correlation between negative urgency and current illicit substance use (r = .13, p > .05). There was a trend towards a positive correlation between negative urgency and current misuse of ADHD stimulant medication (r = .24, p = .053), such that those who reported more negative urgency or emotional dysregulation also reported more misuse of ADHD stimulant medication.

Next, regression analyses were used to examine the relationship of negative urgency (emotion dysregulation) to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses with negative urgency as the predictor also mirrored those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, contrary to the hypothesis (*Aim* 2, Hyp 2c), linear regression analysis revealed that negative urgency did not predict current alcohol consumption, r^2 = .005 (adjusted r^2 = .01), F (1, 64) = .30, p > .05. Logistic regression analysis of negative urgency on binge drinking did not result in a significant model (*Cox & Snell R*

Square = .002, p = .749). However, as hypothesized, linear regression analysis revealed that higher negative urgency scores predicted more alcohol-related consequences on the RAPI, r^2 = .27 (adjusted r^2 = .21), F (5, 60) = 4.42, p < .05.

Negative urgency did not predict current marijuana use, r^2 = .002 (adjusted r^2 = .01), F (1, 64) = .132, p > .05. Similarly, logistic regression analysis of negative urgency on classification as a regular marijuana user did not result in a significant model (*Cox & Snell R Square* = .008, p = .472). Moreover, negative urgency did not predict drug-related problems on the SIP-D; r^2 = .03 (adjusted r^2 = .02), F (1, 64) = 2.01, p > .05. In addition, negative urgency did not predict current Other illicit drug use (*Cox & Snell R Square* = .018, p = .277). Finally, logistic regression results revealed that a model with negative urgency as the predictor variable with ADHD stimulant misuse as the criterion variable was significant, accounting for approximately 16% of the variance (*Cox & Snell R Square* = .164, p = .038), such that higher negative urgency or dysregulation predicted misusing ADHD stimulant medication in the last year. However, after controlling for age, sex, current year in college, and history of conduct problems, negative urgency no longer emerged as a significant predictor. Higher year in college (B = -1.587, p = .041) and more conduct problems in childhood (B = .282, p = .046) emerged as significant covariates that accounted for the majority of the variance in the model. *Table 39* displays detailed results of the linear regression statistics, while *Table 40* displays results of the logistic regression analyses.

Table 39. Linear Regression, Negative Urgency on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	.069	3.691	.550	*p* = .584
# Current Alcohol Consequences	.264	.413	2.347	*p* = .022*
Current Marijuana Use	.045	.140	-.363	*p* = .718
Current Drug Consequences	.174	.294	1.417	*p* = .161

***** $p < .05$
# : Controlled for age, sex, and current year in college.

Table 40. Logistic Regression, Negative Urgency on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	.027	.086	.102	.973	*p* = .749
Regular Mar User	-.061	.086	.512	1.063	*p* = .474
Current Illicit Use	.113	.105	1.152	.893	*p* = .283
# ADHD Stim Misuse	.184	.111	2.731	1.202	*p* = .098

: Controlled for age, sex, and current year in college.

In summary, various analyses in which negative urgency or emotion dysregulation scores were used to predict substance use or substance use consequences resulted in minimal findings within this sample. In fact, there was only one case where the results were significant. Specifically, participants who reported higher negative urgency, reported more alcohol-related negative consequences on the RAPI. Overall, in this sample of all ADHD college students, negative urgency (emotion dysregulation) was not a good predictor of substance use patterns; however, it proved useful in predicting alcohol-related negative consequences.

Executive Functioning Deficits on the BDEFS-CA. Executive functioning deficits were measured using the BDEFS-CA. Since the child and adolescent version was administered, raw total scores were used in all analyses. The hypothesis (*Aim* 2, Hyp 2d) was that more executive functioning deficits (i.e., higher scores on the BDEFS-CA) would relate to more substance use and associated negative consequences in this sample. Contrary to the hypotheses, correlational results showed that executive functioning deficits were not correlated with current alcohol consumption ($r = -.11$, $p > .05$), binge drinking status ($r = -.07$, $p > .05$), and alcohol-related negative consequences on the RAPI ($r = .09$, $p > .05$). Similarly, executive functioning deficits were not correlated with current marijuana use ($r = .10$, $p > .05$) or being classified as a regular marijuana user ($r = .11$, $p > .05$). As hypothesized, more executive functioning deficits were positively correlated with more drug-related consequences on the SIP-D ($r = .32$, $p < .01$). Surprisingly, executive functioning deficits were not correlated with current illicit substance use ($r = .13$, $p > .05$) or current misuse of ADHD stimulant medication ($r = .01$, $p > .05$).

Next, regression analyses were used to examine the relationship of executive functioning deficits (BDEFS-CA) to current substance use and consequences, controlling for demographics and history of conduct problems. Results of linear and logistic regression analyses mirrored those of the correlational analyses. This remained true even when controlling for current age, sex, current year in college, and history of conduct problems, unless otherwise specified. Specifically, contrary to the hypothesis (*Aim 2*, Hyp 1a), Linear regression analysis revealed that executive functioning deficits did not predict current alcohol consumption, $r^2 = .01$ (adjusted $r^2 = -.003$), F (1, 64) = .77, $p > .05$. Further, logistic regression analysis of executive functioning deficits on binge drinking status did not result in a significant model (*Cox & Snell R Square* = .005, $p = .563$). Moreover, executive functioning deficits did not predict alcohol-related negative consequences on the RAPI, $r^2 = .007$ (adjusted $r^2 = -.008$), F (1, 64) = .463, $p > .05$.

Similarly, linear regression revealed that executive functioning deficits did not predict marijuana use, $r^2 = .009$ (adjusted $r^2 = -.006$), F (1, 64) = .593, $p > .05$. Logistic regression analysis revealed that executive functioning deficits did not predict being classified as a regular marijuana user currently (*Cox & Snell R Square* = .016, $p = .299$). As hypothesized, more reported executive functioning deficits significantly predicted more drug-related problems on the SIP-D, $r^2 = .23$ (adjusted $r^2 = .16$), F (5, 60) = 3.51, $p < .01$, however, it did not predict current other illicit use (*Cox & Snell R Square* = .011, $p = .398$) or misuse of ADHD stimulant medication (*Cox & Snell R Square* = .000, $p = .938$). *Table 41* displays detailed results of the linear regression statistics, while *Table 42* displays results of the logistic regression analyses.

Table 41. Linear Regression, Executive Functioning Deficits on Current Substance Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	Standardized (B)	SE	*t*	Sig
Current Alcohol Use	-.109	.298	-.879	*p* = .328
Current Alcohol Consequences	.085	.037	.680	*p* = .499
Current Marijuana Use	.096	.011	.770	*p* = .444
# Current Drug Consequences	.269	.024	2.181	*p* = .033*

* p < .05
# : Controlled for age, sex, and current year in college.

Table 42. Logistic Regression, Executive Functioning Deficits on Current Use and Consequences (If Significant: Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Criterion Variables	B	SE	Wald	Odds Ratio	Sig
Binge Drinker	-.004	.007	.336	.996	*p* = .562
Regular Mar User	.008	.008	1.100	1.008	*p* = .294
Current Illicit Use	.006	.007	.713	1.006	*p* = .399
ADHD Stim Misuse	.001	.008	.006	.999	*p* = .938

In summary, various analyses in which deficits in executive functioning (BDEFS-CA total raw scores) were used to predict substance use or substance use consequences resulted in minimal findings within this sample. In fact, there was only one case where the results were significant. Specifically, participants who reported more executive functioning deficits, reported more drug-related negative consequences on the SIP-D. Overall, in this sample of all ADHD college students, executive functioning deficits was not a good predictor of substance use patterns; however, it proved useful in predicting drug-related negative consequences.

ADHD Specific Substance Predictors

Overall, the ADHD specific substance predictors had surprisingly limited value in predicting substance use patterns and associated negative consequences in this sample. In fact, severity of symptoms on the ASRS predicted none of the substance criterion variables. The T.O.V.A. findings were described for RTV, RT, CE, and OE. There were no significant findings for RTV or OE in this sample. Interestingly, T.O.V.A. RT predicted Other illicit drug use, such that those with faster RT reported using Other illicit drugs in the last 90 days. However, as hypothesized, T.O.V.A. CE predicted Other illicit drug use, such that those with more commission errors were also using illicit drugs. There were no other T.O.V.A. findings that were significant. In terms of positive urgency or impulsivity, as hypothesized, those reporting higher levels of impulsivity, reported more drug-related consequences on the SIP-D. However, positive urgency (impulsivity) did not predict any other substance criterion variables. Moreover, as hypothesized, those reporting higher emotion dysregulation, reported more alcohol-related consequences on the RAPI. However, negative urgency (emotion dysregulation) did not predict any other substance criterion variables.

Finally, executive functioning deficits was only successful at predicting drug-related consequences on the SIP-D, such that those reporting more executive functioning deficits, reported more drug-related consequences. Overall, ADHD specific predictors were generally poor at predicting substance use patterns in this sample. However, there did seem to be some association between ADHD specific predictors and the extent of alcohol and drug-related negative consequences associated with substance use.

Aim 2: Exploratory Analyses of Combined General and ADHD Specific Predictors on Substance Use and Consequences

Next, exploratory analyses were conducted to determine the best multiple regression models (incorporating both general and/or ADHD specific significant predictors entered in a single model), predicting substance use patterns and associated negative consequences (*Aim 2*, Hyp 3). Best models were determined by assessing the adjusted R square values for models that predicted the most variance. In addition, standard error and whether the regression equation was significant or not, was considered for the models. The final models were chosen to reflect significant regression equations, with higher R square values and the lowest standard error, compared to other models. After assessing regression statistics for both general and ADHD specific predictors of substance use and related negative consequences, several final multiple regression models were conducted. All analyses included significant predictors (both general and ADHD specific) in single models to assess current substance use and consequences. In addition, all models controlled for age, sex, and current year in college.

First, in terms of alcohol use, all of the general predictors (i.e., age of first alcohol use, history of conduct problems, peer influence, and positive alcohol expectancies) independently predicted current alcohol consumption. Further, contrary to the hypothesis (*Aim* 2, Hyp 3), there were no ADHD specific predictors that significantly predicted current alcohol consumption; therefore, none were entered into this exploratory multiple regression model predicting alcohol use. All of the general substance use predictors (described above) were entered into a single multiple linear regression model. The final model was significant, $r^2 = .379$ (adjusted $r^2 = .300$), F (1, 55) = 4.803, $p < .001$. When examining the individual predictors of this model, only age of first alcohol use emerged as clearly significant, such that younger age of first alcohol use predicted more current alcohol consumption. Of note, peer influence use and positive expectancies approached significance in predicting current alcohol consumption, such that higher peer influence ($p = .056$) and higher positive alcohol expectancies ($p = .061$) related to more alcohol consumption. Results of the multiple linear regression analysis are displayed on *Table 43* below.

Table 43. Multiple Linear Regression, General Predictors of Alcohol Consumption (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	*t*	Sig
Predictor: Age of First Alcohol Use	-.258	5.311	-2.016	$p = .049$*
Predictor: Conduct Problems	.144	5.345	1.119	$p = .268$
Predictor: Peer Influence	.219	1.169	1.954	$p = .056$
Predictor: Alcohol Exp	.234	1.506	1.911	$p = .061$
Covariate: Age	-.212	9.377	-1.239	$p = .221$
Covariate: Sex	-.105	19.933	-.922	$p = .361$
Covariate: Year in College	.227	20.771	1.366	$p = .178$

* $p < .05$

In addition to total alcohol consumption, binge drinking was examined. Contrary to the hypothesis, there were no ADHD specific predictors that significantly predicted binge drinking; therefore, none were entered into this exploratory multiple regression model predicting binge drinking status. However, age of first alcohol use, history of conduct problems, peer influence, and positive alcohol expectancies all predicted binge drinking status and were entered into a single multiple logistic regression model. The final model was significant, accounting for approximately 43% of the variance (*Cox & Snell R Square* = .426, *p* = .000), with younger age of first alcohol use predicting classification as a binge drinker, again emerging as the only unique significant predictor. Of note, sex emerged as a significant covariate, such that being male predicted classification as a binge drinker. Results of the multiple logistic regression analysis are displayed on *Table 44* below.

Table 44. Multiple Logistic Regression, General Predictors of Binge Drinking (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	Wald	Odds Ratio	Sig
Predictor: Age of First Alcohol Use	-.800	.342	5.475	.449	*p* = .019*
Predictor: Conduct Problems	.447	.309	2.096	1.564	*p* = .148
Predictor: Peer Influence	.104	.058	3.240	1.109	*p* = .072
Predictor: Alcohol Exp	.007	.064	.011	1.007	*p* = .918
Covariate: Age	-.223	.357	.388	.800	*p* = .534

Covariate: Sex	-2.128	.983	4.683	.119	$p = .030$*
Covariate: Year in College	-.033	.808	.002	.967	$p = .967$

* $p < .05$

Next, alcohol-related consequences on the RAPI were examined. Results of prior regression analyses indicated that age of first alcohol use, history of conduct problems, and positive alcohol expectancies were significant general predictors and negative urgency (emotion dysregulation) was an ADHD specific predictor of alcohol-related consequences on the RAPI. These variables were entered into a single multiple linear regression model, controlling for current age, sex, and current year in college. There were several significant models; however, the best model was one that did not include emotion dysregulation as a predictor. This final model was significant, $r^2 = .576$ (adjusted $r^2 = .261$), F (1, 56) = 4.640, $p < .01$. When examining the individual predictors of this model, only positive alcohol expectancies emerged as a significant unique predictor, such that higher positive alcohol expectancies predicted more alcohol-related negative consequences. Current year in college was a significant covariate, such that higher year in college predicted more alcohol-related negative consequences in this sample. Results of the multiple linear regression analysis are displayed on *Table 45*.

Table 45. Multiple Linear Regression, General Predictors of Alcohol-Related Negative Consequences on the RAPI (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	*t*	Sig

Predictor: Age of First Alcohol Use	-.151	.703	-1.161	*p* = .251
Predictor: Conduct Problems	.161	.718	1.224	*p* = .226
Predictor: Alcohol Exp	.358	.199	2.880	*p* = .006**
Covariate: Age	-.337	1.256	-1.921	*p* = .060
Covariate: Sex	.230	2.677	1.961	*p* = .055
Covariate: Year in College	.360	2.791	2.110	*p* = .039*

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

In terms of marijuana use, general predictors including, age of first marijuana use, history of conduct problems, and positive marijuana expectancies independently predicted current marijuana use. Contrary to the hypothesis, there were no ADHD specific predictors that significantly predicted current marijuana use; therefore, none were entered into this exploratory multiple linear regression model. Therefore, the general predictors mentioned above were entered into a single multiple linear regression model. The final model was significant, $r^2 = .508$ (adjusted $r^2 = .432$), F (1, 39) = 6.715, $p < .001$. When examining individual predictors of this model, positive marijuana expectancies emerged as the only unique significant predictor, such that greater positive marijuana expectancies predicted more current marijuana use. Of note, younger age of first marijuana use approached significance ($p = .053$) in predicting more current marijuana use in this model. Results of the multiple linear regression analysis are displayed on *Table 46* below.

Table 46. Multiple Linear Regression, General Predictors of Current Marijuana Use (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	*t*	Sig
Predictor: Age of First Marijuana Use	-.256	.234	-1.994	*p* = .053
Predictor: Conduct Problems	.045	.207	.324	*p* = .748
Predictor: Marijuana Exp	.568	.021	4.193	*p* = .000**
Covariate: Age	.076	.366	.485	*p* = .630
Covariate: Sex	-.061	.783	-.518	*p* = .607
Covariate: Year in College	-.019	.852	-.119	*p* = .906

** $p < .01$

In addition to current marijuana use, classification as a regular marijuana user (1x or more per week in last 90 days) was examined. General predictors including, age of first marijuana use, history of conduct problems, and positive marijuana expectancies all independently predicted classification as a regular marijuana user. Contrary to the hypothesis, there were no ADHD specific predictors that significantly predicted classification as a regular marijuana user, therefore none were entered into the exploratory multiple logistic regression model. The general predictors mentioned above were entered into a single multiple logistic regression model. The final model was significant, accounting for approximately 43% of the variance (*Cox & Snell R Square* = .427, p = .000), with higher positive marijuana expectancies predicting classification as a regular marijuana user, emerging as the only unique significant predictor. Results of the multiple logistic regression analysis are displayed on *Table 47* below.

Table 47. Multiple Logistic Regression, General Predictors of Classification as a Regular Marijuana User (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	Wald	Odds Ratio	Sig
Predictor: Age of First Marijuana Use	-.518	.313	2.739	.596	*p* = .098
Predictor: Conduct Problems	-.129	.223	.332	.879	*p* = .564
Predictor: Marijuana Exp	.097	.034	8.302	1.102	*p* = .004**
Covariate: Age	.274	.396	.479	1.315	*p* = .489
Covariate: Sex	-1.545	1.048	2.174	.213	*p* = .140
Covariate: Year in College	-.224	.809	.077	.799	*p* = .782

** *p* < .01

Current Other illicit drug use was also examined. Upon reviewing the results of linear and logistic regression analysis, findings indicated that only positive marijuana expectancies were a significant general predictor and both T.O.V.A. RT and CE were significant ADHD specific predictors of Other illicit drug use. These variables were entered into a single multiple logistic regression model, controlling for current age, sex, and current year in college. When all three predictors were entered there was a significant model; however, upon further examination none of the single predictors were independently significant. However, a model where T.O.V.A. RT was removed produced lower standard error for the variables and was thought to be the best model. This final model was significant; however, it only accounted for approximately 16% of the variance (*Cox & Snell R Square* = .159, p = .043). Interestingly, history of illicit drug use and more T.O.V.A. commission errors (impulsivity) predicted current Other illicit drug in this model. Results of the multiple logistic regression analysis are displayed on *Table 48* below.

Table 48. Multiple Logistic Regression, General and ADHD Specific Predictors of Current Other Illicit Drug Use (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	Wald	Odds Ratio	Sig
Predictor: History of Illicit Drug Use	1.556	.790	3.885	4.740	p = .049*
Predictor: T.O.V.A. CE	-.036	.017	4.265	.965	p = .039*
Covariate: Age	-.477	.407	1.371	.621	p = .242
Covariate: Sex	-.724	.737	.966	.485	p = .326
Covariate: Year in College	.887	.747	1.409	2.427	p = .235

* $p < .05$

In terms of drug use negative consequences, results of prior regression analyses were examined. Findings indicated that history of illicit drug use, history of conduct problems, and positive marijuana expectancies were significant general predictors and both positive urgency (impulsivity) and the BDEFS-CA (executive functioning deficits) were ADHD specific predictors of drug-related consequences on the SIP-D. These variables were entered into a single multiple linear regression model, controlling for current age, sex, and current year in college. Several models were significant; however, the best model included all predictors except the BDEFS-CA. This final model was significant, $r^2 = .492$ (adjusted $r^2 = .431$), F (1, 58) = 8.022, $p < .001$ accounting for approximately half of the variance in SIP-D scores. When examining individual predictors of this model, history of illicit drug use, positive marijuana expectancies, and positive urgency (impulsivity) all emerged as significant predictors, such that having a history of illicit drug use, greater positive marijuana expectancies, and higher impulsivity predicted more drug-related consequences on the SIP-D. Results of the multiple linear regression analysis are displayed on *Table 49* below.

Table 49. Multiple Linear Regression, General and ADHD Specific Predictors of Current Drug Use Consequences (Controlling for Age, Sex, and Current Year in College).

Predictor Variables / Covariates	Standardized (B)	SE	*t*	Sig
Predictor: History of Illicit Drug Use	.259	1.623	2.299	*p* = .025*
Predictor: Conduct Problems	.052	.383	.454	*p* = .652
Predictor: Marijuana Exp	.452	.032	4.366	*p* = .000**
Predictor: Impulsivity	.256	.245	2.666	*p* = .010*
Covariate: Age	-.211	.678	-1.462	*p* = .149
Covariate: Sex	.079	1.455	.802	*p* = .426
Covariate: Year in College	.166	1.579	1.115	*p* = .269

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

Finally, misuse of ADHD stimulant medication was examined by reviewing results of prior logistic regression analyses. Surprisingly, findings indicated that only positive marijuana expectancies were a significant general predictor of misuse of ADHD stimulant medication in this sample. Moreover, there were no significant ADHD specific predictors of misuse of ADHD stimulant medication. Therefore, multiple logistic regression analysis was not needed to determine the best predictors of misuse of ADHD stimulant medication. To review, logistic regression analysis of positive marijuana expectancies on misuse of ADHD stimulant medication resulted in a significant model but only accounted for approximately 4.0% of the variance in the criterion (*Cox & Snell R Square* = .010, p = .425), with higher marijuana expectancies predicting misuse of ADHD stimulant medication.

Summary of Exploratory Analyses of General and ADHD Specific Predictors

In summary, various multiple linear and logistic regression analyses were used to determine the best predictors of substance use patterns and associated negative consequences in this sample. Overall, history of substance use and positive substance use expectancies emerged as important predictors of many of the substance criterion variables. Further, ADHD specific factors only minimally impacted the results, with most criterion variables being predicted by general substance use predictors.

In terms of alcohol use, age of first alcohol use was the most significant predictor of both current alcohol consumption and binge drinker status. Specifically, participants that reported using alcohol at younger ages also reported more current alcohol consumption and were classified as binge drinkers. The regression models accounted for approximately 40% and 43% of the variance in current alcohol use and binge drinking status, respectively. Further, higher alcohol expectancies predicted more alcohol-related negative consequences on the RAPI; however, no other predictors were significant. This regression model accounted for approximately 58% of the variance in RAPI scores.

Similarly, higher positive marijuana expectancies predicted more current marijuana use and classification as a regular marijuana user; however, no other predictors were significant. The regression models accounted for approximately 51% and 43% of the variance in current marijuana use and classification as a regular marijuana user, respectively. In addition, history of illicit drug use and more T.O.V.A. CE (impulsivity) predicted current Other illicit drug use but accounted for only 16% of the variance in this sample. Finally, predicting misuse of ADHD stimulant medication was difficult in this sample. Specifically, only positive marijuana expectancies were a significant predictor of misuse of ADHD stimulant medication; however, this only accounted for 4.0% of the variance. Interestingly, positive urgency (impulsivity) did emerge as a significant ADHD specific predictor of drug-related consequences in a multiple linear regression model. Specifically, history of illicit drug use, higher positive marijuana expectancies, and higher positive urgency or impulsivity emerged as significant predictors of more drug-related consequences on the SIP-D, which accounted for approximately 50% of the variance in SIP-D scores.

ADHD Symptoms (i.e., ASRS) Interactions with Substance Use

Next, the relationship between substance use and severity of ADHD symptoms on the ASRS was assessed in relation to substance use negative consequences. It was hypothesized that current substance use would interact with severity of ADHD symptoms to produce more alcohol and drug related negative consequences in the sample (*Aim* 2, Hyp 4). In order to assess the interaction of ASRS with substance use on substance use negative consequences, moderation analyses were run using the PROCESS Macro and SPSS (Versions 24 and 25, Greenville, NC), using a bootstrapping technique generating 5,000 random samples with replacement from the data set. Using this technique all variables are automatically mean centered to create an interaction term before analyses are conducted. All moderation analyses controlled for age, sex, current year in college, and history of conduct problems.

Using the PROCESS Macro, findings revealed a significant overall model of the ASRS, with current alcohol consumption as the moderating variable, and alcohol-related negative consequences on the RAPI as the criterion variable, F (7, 58) = 10.56, $p <$ .001, R^2= .56. However, the interaction of the ASRS and current alcohol consumption was not significant in predicting alcohol-related consequences, b = .000, t(58) = .190, p = .850. When examining the model further, there was a main effect for current alcohol consumption, b = .082, t(58) = 6.844, p = .000; however, no main effect for the ASRS. Further, being female emerged as a significant covariate, with women experiencing more alcohol-related consequences. Specific results of this moderation analysis are displayed on *Table 50*.

Table 50. PROCESS Macro Moderation, Interaction of ASRS and Current Alcohol Consumption on RAPI (Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor Variables / Covariates	Unstandardized (B)	SE	*t*	Sig

Predictor: Interaction of ASRS and Current Alcohol Use	.000	.001	.190	*p* = .850
Covariate: Age	-1.261	1.001	-1.260	*p* = .213
Covariate: Sex	5.804	2.312	2.510	*p* = .015*
Covariate: Year in College	4.147	2.281	1.818	*p* = .074
Covariate: Conduct Problems	.482	.526	.915	*p* = .364

* $p < .05$

Next, moderation analysis findings revealed a significant overall model of the ASRS, with binge drinking status as the moderating variable, and alcohol-related negative consequences on the RAPI as the criterion variable, F (7, 58) = 5.065, $p < .001$, R^2= .379. However, the interaction of the ASRS and binge drinking status was not significant in predicting alcohol-related consequences, b = -.064, t(58) = -.303, p = .763. When examining the model further, there was a main effect for binge drinking status, b = 10.801, t(58) = 4.043, p = .000; however, there was no main effect for the ASRS. Further, being female and higher year in college emerged as significant covariates, while greater history of conduct problems approached significance. Specific results of this moderation analysis are displayed on *Table 51*.

Table 51. PROCESS Macro Moderation, Interaction of ASRS and Binge Drinking on RAPI (Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor Variables / Covariates	Unstandardized (B)	SE	*t*	Sig
Predictor: Interaction of ASRS and Binge Drinking	-.064	.211	-.303	*p* = .763

Covariate: Age	-1.481	1.201	-1.233	*p* = .223
Covariate: Sex	6.315	2.829	2.232	*p* = .029*
Covariate: Year in College	6.770	2.603	2.601	*p* = .012*
Covariate: Conduct Problems	1.202	.610	1.968	*p* = .054

* $p < .05$

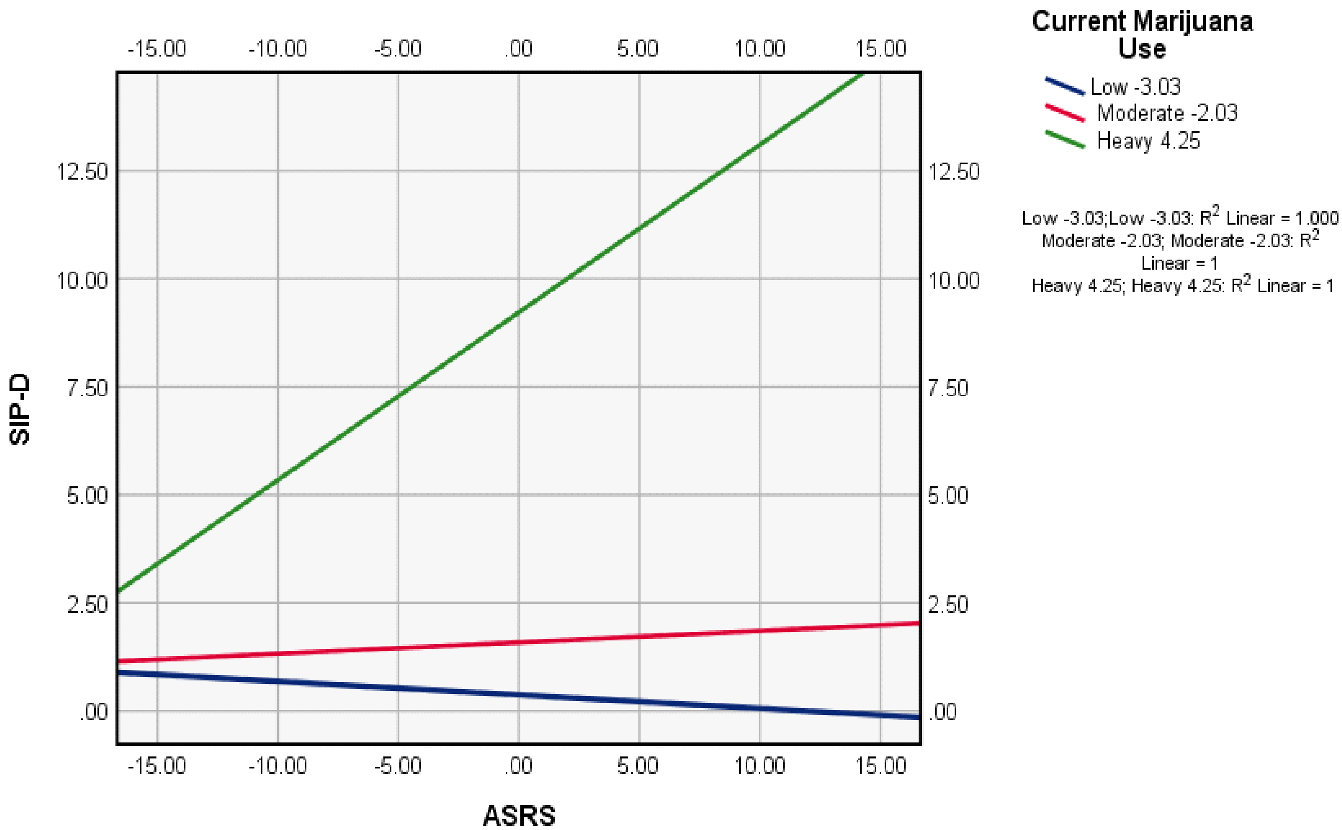
Next, the interaction between the ASRS and drug use on drug use consequences on the SIP-D was examined. Findings revealed a significant overall model of the ASRS, with current marijuana use as the moderating variable, and drug-related negative consequences on the SIP-D as the criterion variable, F (7, 58) = 11.773, $p < .001$, $R^2 = .587$. Of note, there were significant main effects for both the ASRS, $b = .143$, $t(58) = 2.427$, $p = .018$, and current marijuana use, $b = 1.216$, $t(58) = 6.054$, $p = .000$. As hypothesized, the interaction of greater severity of symptoms on the ASRS and more current marijuana use was significant in predicting more drug-related negative consequences on the SIP-D. When examining the model further, higher year in college emerged as a significant covariate, while younger current age approached significance. Upon post hoc analyses of indirect effects, findings revealed a significant indirect effect of greater marijuana use (heavy use) and the SIP-D, $b = .388$, t = 4.309, $p = .000$, such that greater severity of symptoms of ADHD predicted more drug-related consequences, but only at high levels of marijuana use. There were no significant indirect effects at moderate or low marijuana use. Specific results of this moderation analysis are displayed on *Table 52*. In addition, *Figure 1* visually displays the results of the moderation analysis. Specifically, at higher levels of marijuana use combined with increased severity of symptoms on the ASRS there are increased reported negative consequences on the SIP-D.

Table 52. PROCESS Macro Moderation, Interaction of ASRS and Current Marijuana Use on SIP-D (Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor Variables / Covariates	Unstandardized (B)	SE	*t*	Sig
Predictor: Interaction of ASRS and Current Marijuana Use	.058	.015	3.752	p = .000**
Covariate: Age	-1.148	.616	-1.865	p = .067
Covariate: Sex	-.835	1.436	-.581	p = .563
Covariate: Year in College	3.836	1.385	2.770	p = .008**
Covariate: Conduct Problems	.202	.329	.613	p = .542

** $p < .01$

Figure 1. Interaction of ASRS and Current Marijuana Use on SIP-D



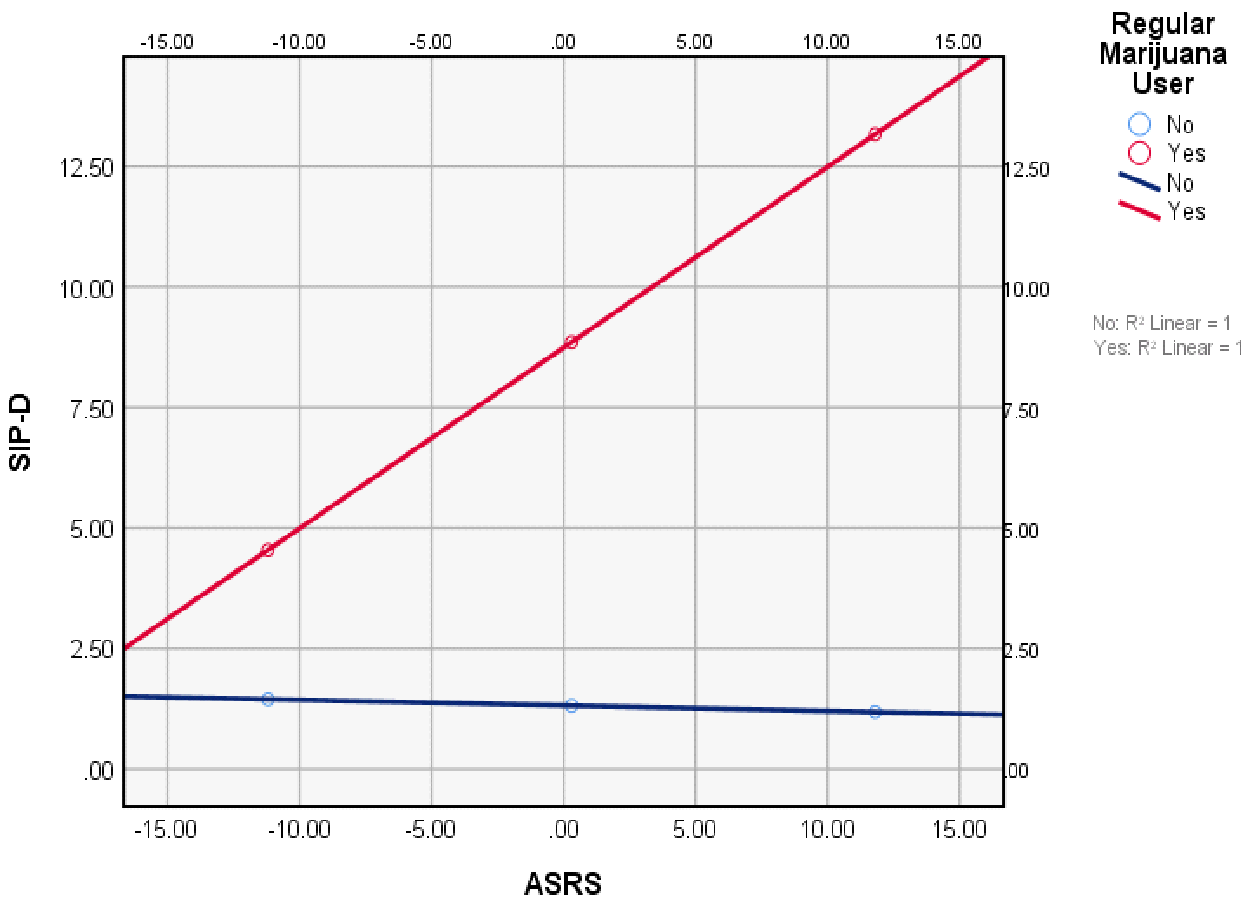
Similarly, moderation analysis findings revealed a significant overall model of the ASRS, with classification as a regular marijuana user (once or more per week in the last 3 months) as the moderating variable, and drug-related negative consequences on the SIP-D as the criterion variable, F (7, 58) = 8.812, p < .001, R^2= .515. Of note, there was a significant main effect for classification as a regular marijuana user, b = 7.425, t(58) = 4.953, p = .000. However, the ASRS did not have a significant main effect on the SIP-D, b = -.011, t(58) = -.154, p = .878. As hypothesized, the interaction of greater severity of symptoms on the ASRS and being classified as a regular marijuana user was significant in predicting more drug-related negative consequences on the SIP-D. When examining the model further, higher year in college emerged as a significant covariate. Upon post hoc analyses of indirect effects, findings revealed a significant indirect effect of classification as a regular marijuana user and the SIP-D, *b* = .375, t = 3.553, *p* = .001, such that greater severity of symptoms of ADHD predicted more drug-related consequences, but only among those classified as regular marijuana users. There was no significant indirect effect for those not classified as regular marijuana users. Specific results of this moderation analysis are displayed on *Table 53*. In addition, *Figure 2* visually displays the results of the moderation analysis. Specifically, at higher levels of severity of symptoms on the ASRS combined with classification as a regular marijuana user, there are increased reported negative consequences on the SIP-D.

Table 53. PROCESS Macro Moderation, Interaction of ASRS and Regular Marijuana User on SIP-D (Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor Variables / Covariates	Unstandardized (B)	SE	*t*	Sig
Predictor: Interaction of ASRS and Current Marijuana Use	.387	.121	3.201	*p* = .002**
Covariate: Age	-1.111	.667	-1.666	*p* = .101
Covariate: Sex	-.130	1.571	-.083	*p* = .934
Covariate: Year in College	3.504	1.498	2.339	*p* = .023*
Covariate: Conduct Problems	.475	.345	1.377	*p* = .174

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

Figure 2. Interaction of ASRS and Classification as a Regular Marijuana User on SIP-D



Finally, moderation analysis findings revealed a significant overall model with the ASRS, and Other Illicit drug use as the moderating variable, and drug-related negative consequences on the SIP-D as the criterion variable, F (7, 58) = 2.229, $p < .05$, R^2= .212. When examining this model further, there were no main effects for either ASRS or current Other Illicit drug use. Moreover, the interaction of the ASRS and current Other Illicit drug use also was not significant in predicting current drug-related negative consequences on the SIP-D, b = .033, t(58) = .175, p = .862. However, more conduct problems in childhood emerged as a significant covariate in the model. Specific results of this moderation analysis are displayed on *Table 54*.

Table 54. PROCESS Macro Moderation, Interaction of ASRS and Other Illicit Drug Use on the SIP-D (Controlling for Age, Sex, Current Year in College, and Conduct Problems).

Predictor Variables / Covariates	Unstandardized (B)	SE	*t*	Sig
Predictor: Interaction of ASRS and Binge Drinking	.033	.189	.175	*p* = .862
Covariate: Age	-1.138	.867	-1.313	*p* = .194
Covariate: Sex	-.324	2.010	-.161	*p* = .872
Covariate: Year in College	2.413	1.957	1.233	*p* = .222
Covariate: Conduct Problems	1.047	.451	2.322	*p* = .024

* $p < .05$

In summary, moderation analyses were conducted to examine if attentional symptoms (ASRS) interacted with substance use to influence substance use negative consequences. Evidence for this interaction was found for ASRS and marijuana use in which higher severity of symptoms on the ASRS and more frequent use of marijuana in the last 90 days predicted more drug use consequences on the SIP-D. Moreover, this was true when examining classification as a regular marijuana user, such that those reporting more symptoms on the ASRS and who were classified as regular marijuana users also reported more drug use consequences on the SIP-D. There were no significant results for alcohol use, suggesting that in this sample greater ADHD symptom severity, interacted more with marijuana use in accounting for more substance-related negative consequences.

Aim 3: Psychosocial/Academic Functioning and ADHD Specific Factors

In this section I report on the psychosocial and academic functioning of the sample. Specifically, I provide descriptive data on study participant's depression, anxiety, and social adjustment scores, followed by descriptive data on GPA and academic adjustment (*Aim 3*, A and B). In addition, I report on the relationship between ADHD specific factors (i.e., ASRS, T.O.V.A., SUPPS-P Positive and Negative Urgency, and BDEFS-CA) and the five psychosocial/academic functioning (i.e., PHQ-9, GAD-7, SACQ – Social Adjustment Subscale, GPA, and SACQ – Academic Adjustment Subscale) in the sample. Pearson zero order correlations are reported before linear regression analyses assessing this relationship. It was hypothesized that ADHD specific factors (i.e., more symptoms) would predict higher levels of psychosocial/academic adjustment difficulties (*Aim 3*, Hyp 1 and 2). Regression analyses in which the model was not significant, did not use covariates. However, when significant, all regression analyses were rerun controlling for demographic variables. For each section, tables are presented that display results of the linear regression analyses. In each table, regression analyses that controlled for demographics are indicated with a "#" next to the model.

Psychosocial Adjustment Results. Psychosocial adjustment was measured in terms of depression (PHQ-9 total scores), anxiety (GAD-7 total scores), and social adjustment to college (SACQ – Social Adjustment Subscale, total scores). The current sample contained 34 individuals (51.5%) who met the suggested clinical cut-off score ($\geq$ 8) for depression on the PHQ-9. The PHQ-9 total score ranged from 1 to 25 (*M* = 9.58, SD = 6.44) out of a possible 27 total points, with higher scores indicating more current symptoms of depression. A full description of this measure can be found in *Table 55*, which includes the number of participants who fell into different ranges of depression on the PHQ-9.

Table 55. Patient Health Questionnaire – 9 Descriptive Statistics

PHQ-9 Variables	N (% of Sample)
PHQ-9 Total Score	Range: 0 to 25 out of possible 27 (*M* = 9.58; SD = 6.44)
PHQ-9 Cut Off for Depression	Yes = 34 (51.5%) No = 32 (48.5%)
PHQ-9 None/Minimal Range (0 – 4)	Yes = 16 (24.2%) No = 50 (75.8%)
PHQ-9 Mild Range (5 – 9)	Yes = 20 (30.3%) No – 46 (69.7%)
PHQ-9 Moderate Range (10 – 14)	Yes = 13 (19.7%) No = 53 (80.3%)
PHQ-9 Moderately Severe Range (15 – 19)	Yes = 11 (16.7%) No = 55 (83.3%)
PHQ-9 Severe Range (20 – 27)	Yes = 6 (9.1%) No = 60 (90.9%)

In terms of anxiety, 22 (33.3%) of participants met the suggested clinical cut-off score ($\geq$ 10) on the GAD-7 for current anxiety symptoms. Further, total scores on this measure ranged from 0 to 21 (*M* = 8.06, SD = 6.39) out of a possible 21, with higher scores indicating more current symptoms of anxiety. Detailed results of the GAD-7 can be found in *Table* 56. Lastly, social adjustment to college, as measured on the SACQ –

Social Adjustment subscale ranged from 12 to 73 (*M* = 46.71, SD = 13.86) out of a possible 100, with higher scores indicating better social adjustment to college.

Table 56. Generalized Anxiety Disorder – 7 Descriptive Statistics

GAD – 7 Variables	N (% of Sample)
GAD-7 Total Score	Range: 0 to 21 out of possible 21 (*M* = 8.06; SD = 6.39)
GAD-7 Cutoff Score	Yes = 22 (33.3%) No = 44 (66.7%)
GAD-7 Mild Range for Anxiety (5 – 9)	Yes = 20 (30.3%) No = 46 (69.7%)
GAD-7 Moderate Range for Anxiety (10 – 14)	Yes = 9 (13.6%) No = 57 (86.4%)
GAD-7 Severe Range for Anxiety (15 – 21)	Yes = 13 (19.7%) No = 53 (80.3%)

Academic Adjustment Results. Academic adjustment to college was measured by self-reported current GPA and academic adjustment (SACQ – Academic Adjustment Subscale). In addition, participants were asked to report their high school GPA upon graduation. Participants, on average reported their high school GPA upon completion was 3.39 (SD = .471) with scores ranging from 2.0 to 4.0. GPA in college was available for fifty-one participants who reported their current college GPA, with scores ranging from .18 to 4.0 (*M* = 2.76, SD = .83). On the SACQ – Academic Adjustment Subscale, participant's scores ranged from 22 to 81 (*M* = 50.68, SD = 11.62) out of a possible 120, with higher scores indicating better academic adjustment to college.

ADHD Specific Predictors in Relationship to Psychosocial and Academic Functioning

It was hypothesized (*Aim 3,* Hyp 1 and Hyp 2), that ADHD specific predictors would predict higher levels of psychosocial and academic difficulties in the sample. To test these hypotheses, Pearson correlations were calculated for all the ADHD specific factors (i.e., reported severity of symptoms on the ASRS, severity of symptoms on T.O.V.A., impulsivity, and executive functioning deficits) and the psychosocial functioning variables (i.e., depression on PHQ-9, anxiety on GAD-7, and social adjustment on the SACQ – Social Adjustment subscale) as well as academic functioning measures (i.e., current GPA and SACQ – Academic Adjustment Subscale). Next, linear and logistic regression analyses were used to determine if the ADHD specific factors predicted psychosocial and academic adjustment in this sample. All regression analyses that were initially significant controlled for age, sex, and current year in college.

Severity of ADHD Symptoms on the ASRS and Psychosocial/Academic Functioning. In terms of self-reported severity of current ADHD symptoms, as hypothesized (*Aim* 3, Hyp 1), results showed significant positive correlations between the ASRS total scores and PHQ-9 total scores (r = .596, p < .01) and GAD-7 total scores (r = .529, p < .01). Those, who reported higher severity of symptoms on the ASRS also reported more current symptoms of depression and anxiety. Further, there was a negative correlation between the ASRS and the SACQ – Social Adjustment Subscale (r = -.299, p < .05), such that those reporting higher severity of symptoms on the ASRS also reported being less socially adjusted to college. Contrary to the hypothesis, the ASRS was not correlated with current college GPA (r = -.195, p > .05). However, as expected, the ASRS was negatively correlated with the SACQ – Academic Adjustment Subscale (r = -.393, p < .05), such that those reporting higher severity of symptoms on the ASRS also reported more academic adjustment problems to college.

Next, regression analyses were used to examine the relationship of severity of ADHD symptoms on the ASRS to psychosocial and academic functioning, controlling for demographics. Results of linear regression analyses were similar to those of the correlational analyses. This remained true even when controlling for current age, sex, and current year in college, unless otherwise specified.

Specifically, as hypothesized (*Aim* 3, Hyp 1), linear regression analysis revealed that self-reported severity of ADHD symptoms on the ASRS predicted current depression symptoms on the PHQ-9, r^2 = .43 (adjusted r^2 = .39), F (4, 61) = 11.43, p < .01. Higher severity of symptoms on the ASRS, predicted more current symptoms of depression. Moreover, higher severity of symptoms on the ASRS significantly predicted more current symptoms of anxiety on the GAD-7, r^2 = .33 (adjusted r^2 = .28), F (4, 61) = 7.43, p < .01. However, contrary to the hypothesis, severity of symptoms on the ASRS predicting social adjustment on the SACQ did not result in a significant model, r^2 = .121 (adjusted r^2 = .06), F (4, 61) = 2.10, p > .05. The model was initially significant; however, after controlling for age, sex, and current year in college it was no longer significant. In terms of academic functioning, contrary to the hypothesis (*Aim 3*, Hyp 2), severity of symptoms on the ASRS predicting current GPA did not result in a significant model, r^2 = .04 (adjusted r^2 = .02), F (1, 49) = 1.93, p > .05. Finally, as hypothesized, higher severity of symptoms on the ASRS significantly predicted more academic adjustment difficulties on the SACQ, $r^2 = .12$ (adjusted $r^2 = .13$), F (5, 60) = 2.88, $p < .05$. *Table 57* displays detailed results of the linear regression analyses.

Table 57. Linear Regression, ASRS on Psychosocial and Academic Functioning (If Significant: Controlling for Age, Sex, and Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig
# PHQ-9 (Depression)	.521	.057	4.932	*p* = .000**
# GAD-7 (Anxiety)	.488	.062	4.255	*p* = .000**
# SACQ – Social Adjustment	-.296	.153	-2.262	*p* = .027
GPA	-.195	.009	-1.389	*p* = .171
# SACQ – Academic Adjustment	-.473	.130	-3.572	*p* = .001**

** $p < .01$
# : Controlled for age, sex, and current year in college.
Note: Some of the individual statistics in the table will be displayed as significant, even if the regression model was not significant as discussed above. For ease of interpretation these will not be notated with two asterisks. Only significant statistics that the regression model was significant for will be notated with two asterisks.

In summary, severity of ADHD symptoms on the ASRS significantly predicted both psychosocial and academic functioning in this sample. Specifically, higher severity of symptoms on the ASRS predicted more current symptoms of depression and anxiety on the PHQ-9 and GAD-7, respectively. Moreover, more academic adjustment difficulties on the SACQ were predicted by higher scores on the ASRS. However, the ASRS was not significant in predicting current GPA or social adjustment, after controlling for age, sex, and current year in college.

Severity of ADHD Symptoms on the T.O.V.A. and Psychosocial/Academic Functioning. As previously discussed, the T.O.V.A. was used as an objective behavioral measure of ADHD symptom impairment within this sample. Standard Scores were used for all analyses of the T.O.V.A. and can be interpreted as follows: Scores above 110 are above average, scores between 85 – 110 are average, scores between 80 – 85 are borderline, scores below 80 are not within normal limits. T.O.V.A. overall Reaction Time Variability (RTV), overall Response Time (RT), overall Commission Errors (CE) and overall Omission Errors (OE) were calculated using standard scores. Higher scores indicate less impairment due to ADHD symptoms, while lower scores indicate greater ADHD symptom impairment. The hypothesis (*Aim* 3, Hyp 1 and 2), was that lower standard scores on the T.O.V.A. RTV, RT, CE, and OE would relate to more psychosocial and academic difficulties in functioning.

Contrary to this hypothesis, correlational findings indicated no significant correlations between the T.O.V.A. RTV, RT, CE, and OE and depression symptoms on the PHQ-9 (r = -.16, p > .05; r = -.11, p > .05; r = .07, p > .05; r = -.01, p > .05), respectively. Moreover, T.O.V.A. RTV, RT, CE, and OE variables also were not correlated with anxiety symptoms on the GAD-7 (r = -.08, p > .05; r = -.02, p > .05; r = .09, p > .05; r = .01 p > .05), respectively. In addition, T.O.V.A. variables (i.e. RTV, RT, CE, and OE) were not correlated with social adjustment difficulties on the SACQ (r = .10 p > .05; r = .15, p > .05; r = -.05, p > .05; r = .001, p > .05), respectively. Similarly, T.O.V.A. scores (i.e. RTV, RT, CE, and OE) were also not correlated with current GPA (r = .05 p > .05; r = .003, p > .05; r = .236, p > .05; r = .05, p > .05), respectively, or academic adjustment difficulties on the SACQ ($r = .08$, $p > .05$; $r = .06$, $p > .05$; $r = .05$, $p > .05$; $r = -.003$, $p > .05$), respectively.

Next, regression analyses were used to examine the relationship of ADHD symptom impairment on the T.O.V.A. to psychosocial and academic functioning, controlling for demographics, if significant. Results of linear regression analyses mirrored those of the correlational analyses. In terms of psychosocial outcomes, contrary to the hypothesis (*Aim* 3, Hyp 1), linear regression analyses revealed that T.O.V.A. RTV, RT, CE, and OE did not predict depression symptoms on the PHQ-9, $r^2 = .026$ (adjusted $r^2 = .011$), F (1, 64) = 1.69, $p > .05$; $r^2 = .011$ (adjusted $r^2 = -.004$), F (1, 64) = .739, $p > .05$; $r^2 = .005$ (adjusted $r^2 = -.011$), F (1, 64) = .300, $p > .05$; $r^2 = .000$ (adjusted $r^2 = -.015$), F (1, 64) = .011, $p > .05$; respectively. Similarly, linear regression analysis revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) did not predict anxiety symptoms on the GAD-7, $r^2 = .007$ (adjusted $r^2 = -.008$), F (1, 64) = .453, $p > .05$; $r^2 = .000$ (adjusted $r^2 = -.015$), F (1, 64) = .022, $p > .05$; $r^2 = .008$ (adjusted $r^2 = -.008$), F (1, 64) = .495, $p > .05$; $r^2 = .000$ (adjusted $r^2 = -.016$), F (1, 64) = .004, $p > .05$; respectively. Further, linear regression analysis revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) did not predict social adjustment problems on the SACQ, $r^2 = .01$ (adjusted $r^2 = -.005$), F (1, 64) = .671, $p > .05$; $r^2 = .023$ (adjusted $r^2 = .007$), F (1, 64) = 1.486, $p > .05$; $r^2 = .002$ (adjusted $r^2 = -.014$), F (1, 64) = .132, $p > .05$; $r^2 = .001$ (adjusted $r^2 = -.016$), F (1, 64) = .000, $p > .05$; respectively.

Linear regression results on academic functioning outcomes mirrored those of psychosocial outcomes. Specifically, contrary to the hypothesis (*Aim* 3, Hyp 2), linear regression analyses revealed that T.O.V.A. RTV, RT, CE, and OE variables did not predict current GPA, r^2 = .002 (adjusted r^2 = -.018), F (1, 49) = .121, p > .05; r^2 = .000 (adjusted r^2 = -.02), F (1, 49) = .000, p > .05; r^2 = .056 (adjusted r^2 = .036), F (1, 49) = 2.88, p > .05; r^2 = .002 (adjusted r^2 = -.018), F (1, 49) = .10, p > .05; respectively. Similarly, linear regression analysis revealed that T.O.V.A. variables (i.e. RTV, RT, CE, and OE) did not predict academic adjustment problems on the SACQ, r^2 = .006 (adjusted r^2 = -.009), F (1, 64) = .416, p > .05 ; r^2 = .003 (adjusted r^2 = -.012), F (1, 64) = .204, p > .05; r^2 = .002 (adjusted r^2 = -.013), F (1, 64) = .154, p > .05; r^2 = .000 (adjusted r^2 = -.016), F (1, 64) = .001, p > .05; respectively.

Finally, in order to further test if any of the T.O.V.A. variables would significantly predict psychosocial and academic functioning, the TOVA variables (i.e., RTV, RT, CE, and OE) were also dichotomized into those scores that were within normal limits versus those that fell outside normal limits for age and sex. Using these variables in linear regression results completely mirrored the results of using the T.O.V.A. standard scores. Therefore, standard scores are reported throughout. *Table 58* displays results of linear regression analyses, with the T.O.V.A. RTV as the predictor variable. *Table 59* displays results of linear regression analyses with the T.O.V.A. RT as the predictor variable. *Table 60* displays results of linear regression analyses with the T.O.V.A. CE as the predictor variable. Finally, *Table 61* displays results of linear regression analyses with the T.O.V.A. OE as the predictor variable. In all of these tables, demographic variables were not controlled for, due to the regression model findings being non-significant.

Table 58. Linear Regression, T.O.V.A. RTV on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.161	.036	-1.301	*p* = .198
GAD-7 (Anxiety)	-.084	.036	-.673	*p* = .503
SACQ – Social Adjustment	.102	7.015	.819	*p* = .416
GPA	.050	.006	.348	*p* = .730
SACQ – Academic Adjustment	.080	.066	.645	*p* = .521

Table 59. Linear Regression, T.O.V.A. RT on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.107	.041	-.860	*p* = .393
GAD-7 (Anxiety)	-.019	.041	-.149	*p* = .882
SACQ – Social Adjustment	.151	.088	1.219	*p* = .227
GPA	.003	.007	.021	*p* = .984
SACQ – Academic Adjustment	.056	.075	.451	*p* = .653

Table 60. Linear Regression, T.O.V.A. CE on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.068	.041	.548	*p* = .586
GAD-7 (Anxiety)	.088	.041	.703	*p* = .484
SACQ – Social Adjustment	-.045	.089	-.364	*p* = .717
GPA	.236	.006	1.697	*p* = .096

SACQ – Academic Adjustment	.049	.075	.392	*p* = .696

Table 61. Linear Regression, T.O.V.A. OE on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.013	.037	-.106	*p* = .916
GAD-7 (Anxiety)	.008	.036	.062	*p* = .951
SACQ – Social Adjustment	.001	.079	.010	*p* = .992
GPA	.045	.006	.317	*p* = .753
SACQ – Academic Adjustment	-.003	.066	-.026	*p* = .979

In summary, various analyses in which T.O.V.A scores were used to predict psychosocial and academic functioning resulted in minimal findings within this sample. In fact, none of the T.O.V.A. variables were successful at predicting psychosocial and academic problems, even when using dichotomized variables to determine if the T.O.V.A. variable score were within normal limits. Overall, in this sample of all ADHD college students, T.O.V.A. scores were not a good predictor of psychosocial and academic functioning.

Impulsivity and Emotion Dysregulation on the SUPPS-P and Psychosocial/Academic Functioning. Impulsivity and Emotion Dysregulation were measured by positive and negative urgency on the SUPPS-P, which were both expected to be related to psychosocial and academic functioning variables. Specifically, it was hypothesized that higher scores on the positive urgency scale (greater impulsivity) and negative urgency scale (greater emotion dysregulation) would relate to more psychosocial and academic adjustment difficulties within the sample. First, positive urgency was examined.

Contrary to the hypothesis (*Aim* 3, Hyp 1 and 2), Correlational findings indicated no significant correlations between positive urgency (i.e., impulsivity) scores and depression symptoms on the PHQ-9 (r = -.11, p > .05), anxiety symptoms on the GAD-7 (r = -.01, p > .05), or social adjustment problems on the SACQ (r = -.003, p > .05). Similarly, positive urgency was not correlated with current GPA (r = .17, p > .05), or academic adjustment on the SACQ (r = .17, p > .05).

Next, regression analyses were used to examine the relationship of positive urgency (impulsivity) to psychosocial and academic functioning, controlling for demographics. Results of linear regression analyses with positive urgency as the predictor mirrored those of the correlational analyses. Specifically, contrary to the hypothesis (*Aim* 3, Hyp 1 and 2), linear regression analysis revealed that positive urgency did not predict current depression symptoms on the PHQ-9, r^2 = .012 (adjusted r^2 = -.003), F (1, 64) = .808, p > .05, and anxiety symptoms on the GAD-7, r^2 = .000 (adjusted r^2 = -.016), F (1, 64) = .005, p > .05. Moreover, linear regression results revealed that positive urgency did not predict social adjustment on the SACQ, r^2 = .028 (adjusted r^2 = .013), F (1, 64) = 1.84, p > .05. Similarly, positive urgency did not predict current GPA, r^2 = .027 (adjusted r^2 = .007), F (1, 49) = 1.366, p > .05, and academic adjustment difficulties on the SACQ, r^2 = .028 (adjusted r^2 = .013), F (1, 64) = 1.84, p > .05. *Table 62* displays detailed results of the linear regression analyses.

Table 62. Linear Regression, Positive Urgency on Psychosocial and Academic Functioning.

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.112	.281	.899	p = .372
GAD-7 (Anxiety)	.008	.281	.068	p = .946
SACQ – Social Adjustment	-.167	.503	1.357	p = .180
GPA	.165	.039	-1.169	p = .248
SACQ – Academic Adjustment	-.167	.503	1.357	p = .180

In summary, various analyses in which impulsivity scores were used to predict psychosocial and academic functioning resulted in no significant findings within this sample. Overall, in this sample of all ADHD college students, positive urgency (impulsivity) was not a good predictor of psychosocial and academic adjustment difficulties.

In terms of emotion dysregulation (i.e., negative urgency on the SUPPS-P), as hypothesized, the findings revealed significant positive correlations between negative urgency total score and depression symptoms on the PHQ-9 (r = .37, p < .01) and with the GAD-7 (r = .30, p < .05), such that those who reported more emotion dysregulation also reported more current symptoms of depression and anxiety. Further, there was a significant negative correlation between negative urgency and social adjustment on the SACQ (r = -.34, p < .01), such that those who reported more emotion dysregulation also reported more social adjustment problems to college. Contrary to the hypothesis, negative urgency was not correlated with current GPA, although it did show a trend towards a negative correlation (r = .27, p = .057), such that those who reported more emotion dysregulation also reported lower current GPA. However, negative urgency was negatively correlated with academic adjustment on the SACQ (r = -.34, p < .01), such that those who reported more emotion dysregulation also reported more academic adjustment difficulties to college.

Next, regression analyses were used to examine the relationship of negative urgency (emotion dysregulation) to current substance use and consequences, controlling for demographics. Results of linear and logistic regression analyses with negative urgency as the predictor were very similar those of the correlational analyses. This remained true even when controlling for current age, sex, and current year in college, unless otherwise specified. Specifically, as hypothesized (*Aim* 3, Hyp 1), linear regression analysis revealed that higher negative urgency predicted more current symptoms of depression on the PHQ-9, r^2 = .349 (adjusted r^2 = .306), F (4, 61) = 8.168, p < .01. Of note, being older and female emerged as significant covariates (p = .027; p = .000). Moreover, linear regression analysis revealed that higher negative urgency scores predicted more symptoms of anxiety on the GAD-7, r^2 = .223 (adjusted r^2 = .172), F (4, 61) = 4.387, p < .01. Of note, being female emerged as a significant covariate (p = .013). Further, higher negative urgency predicted more social adjustment problems on the SACQ, r^2 = .161 (adjusted r^2 = .106), F (4, 61) = 2.921, p < .05. In addition, higher negative urgency predicted lower current GPA, r^2 = .24 (adjusted r^2 = .174), F (4, 46) = 3.641, p < .05, with higher year in college emerging as a significant covariate (p = .033). Finally, higher negative urgency predicted more academic adjustment problems on the SACQ, $r^2 = .199$ (adjusted $r^2 = .146$), F (4, 61) = 3.781, $p < .01$. *Table 63* displays detailed results of the linear regression analyses.

Table 63. Linear Regression, Negative Urgency on Psychosocial and Academic Functioning (If Significant: Controlling for Age, Sex, Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig
# PHQ-9 (Depression)	.392	.223	3.728	$p = .000$**
# GAD-7 (Anxiety)	.315	.242	2.738	$p = .008$**
# SACQ – Social Adjustment	-.343	.545	-2.874	$p = .006$**
# GPA	.344	.035	2.632	$p = .012$*
# SACQ – Academic Adjustment	-.430	.447	-3.681	$p = .000$**

***** $p < .05$
** $p < .01$
# : Controlled for age, sex, and current year in college.

In summary, various analyses in which emotion dysregulation scores were used to predict psychosocial and academic functioning, resulted in substantial findings within this sample. In fact, negative urgency successfully predicted all of the criterion variables. Specifically, participants who reported higher negative urgency (emotion dysregulation), reported more symptoms of depression (PHQ-9), more symptoms of anxiety (GAD-7), greater difficulty with social adjustment to college (SACQ – Social Adjustment Subscale), lower current GPAs, and greater difficulty with academic adjustment to college (SACQ – Academic Adjustment Subscale).

Executive Functioning Deficits on the BDEFS-CA and Psychosocial/Academic Functioning. Executive functioning deficits were measured using the BDEFS-CA. Since this was the child and adolescent version, total raw scores were used in all analyses. The hypotheses (*Aim* 3, Hyp 1 and 2) were that more executive functioning deficits (i.e., higher scores on the BDEFS-CA) would relate to more psychosocial and academic difficulties in the sample. As hypothesized, correlational results showed that executive functioning deficits were positively correlated with depression symptoms on the PHQ-9 (r = .639, p < .01), such that those who reported more executive functioning deficits also reported more symptoms of depression. Further, as hypothesized, executive functioning deficits were positively correlated with anxiety symptoms on the GAD-7 (r = .486, p < .01), such that those who reported more executive functioning deficits also reported more anxiety symptoms. Moreover, executive functioning deficits were negatively correlated with social adjustment on the SACQ (r = -.501, p < .01), such that those who reported more executive functioning deficits also reported more difficulty with social adjustment to college. Similarly, executive functioning deficits were negatively correlated with current GPA (r = -.368, p < .01), such that those who reported more executive functioning deficits also reported lower overall GPAs. Finally, executive functioning deficits were negatively correlated with academic adjustment on the SACQ (r = -.573, p < .01), such that those who reported more executive functioning deficits also reported more academic adjustment difficulties to college.

Next, regression analyses were used to examine the relationship of executive functioning deficits (BDEFS-CA) to psychosocial and academic functioning, controlling for demographics. Results of linear regression analyses mirrored those of the correlational analyses. This remained true even when controlling for current age, sex, and current year in college. Specifically, as hypothesized (*Aim 2*, Hyp 1a), Linear regression analysis revealed that greater executive functioning deficits predicted more current symptoms of depression, $r^2 = .477$ (adjusted $r^2 = .443$), F (4, 61) = 13.904, $p < .01$. Of note, being older and female approached significance as covariates ($p = .057$; $p = .058$), respectively. Further, linear regression analysis revealed that greater executive functioning deficits predicted more current symptoms of anxiety, $r^2 = .284$ (adjusted $r^2 = .237$), F (4, 61) = 6.038, $p < .01$. In addition, linear regression analysis revealed that greater executive functioning deficits predicted more social adjustment difficulties to college, $r^2 = .267$ (adjusted $r^2 = .219$), F (4, 61) = 5.564, $p < .01$. In terms of academic functioning, results of linear regression analyses mirrored those of psychosocial functioning. Specifically, linear regression analysis revealed that greater executive functioning deficits predicted lower current GPA, $r^2 = .301$ (adjusted $r^2 = .24$), F (4, 46) = 4.957, $p < .01$. Of note, higher year in college emerged as a significant covariate ($p = .029$). Finally, Linear regression analysis revealed that greater executive functioning deficits predicted more academic adjustment difficulties to college, $r^2 = .4$ (adjusted $r^2 = .319$), F (4, 61) = 8.609, $p < .01$. *Table 64* displays detailed results of the linear regression analyses.

Table 64. Linear Regression, BDEFS-CA on Psychosocial and Academic Functioning (If Significant: Controlling for Age, Sex, Current Year in College).

Criterion Variables	Standardized (B)	SE	*t*	Sig

# PHQ-9 (Depression)	.558	.017	5.679	p = .000**
# GAD-7 (Anxiety)	.418	.020	3.640	p = .001**
# SACQ – Social Adjustment	-.498	.043	-4.282	p = .000**
# GPA	-.431	.003	-3.395	p = .001**
# SACQ – Academic Adjustment	-.619	.034	-5.697	p = .000**

** $p < .01$
# : Controlled for age, sex, and current year in college.

Various analyses in which deficits in executive functioning (BDEFS-CA total raw scores) were used to predict psychosocial and academic functioning resulted in significant findings in this sample. In fact, greater executive functioning deficits significantly predicted more current symptoms of depression and anxiety, more difficulty socially adjusting to college, lower current GPA, and more difficulty academically adjusting to college.

In summarizing findings related to *Aim 3*, as expected several ADHD specific factors were found to be significantly related to the psychosocial and academic adjustment of participants. Specifically, severity of ADHD symptoms on the ASRS, emotion dysregulation on the SUPPS-P (negative urgency), and executive functioning deficits were related to psychosocial and academic functioning. However, neither impulsivity from the SUPPS-P (positive urgency) or the standardized scores on the T.O.V.A. predicted any psychosocial or academic adjustment difficulties. Greater severity of symptoms on the ASRS predicted more symptoms of depression, anxiety, and academic adjustment difficulties. Further, higher emotional dysregulation predicted more symptoms of depression and anxiety, more social and academic adjustment difficulties, and lower overall college GPA. Finally, more executive functioning deficits on the BDEFS-CA predicted more symptoms of depression and anxiety, more social and academic adjustment difficulties, and lower overall college GPA.

Aim 4: The Impact of Substance Use on Psychosocial and Academic Functioning

In this section I first report on the direct relationship of substance use patterns to psychosocial and academic functioning among the sample. In a later section, I explore possible interactions of substance use variables and ADHD predictors on adjustment. In regard to alcohol consumption, the alcohol substance use variables (i.e., total alcohol consumption and binge drinking (5 or more standard drinks in one sitting), and their relationship to current psychosocial and academic functioning are reported. Next, marijuana variables (i.e., current marijuana use and classification as a regular marijuana user (use at least once a week in last 90 days)), and their relationship to current psychosocial and academic functioning are reported. Finally, other drug use (i.e., current other illicit drug use), and misuse of ADHD stimulant medication are examined for their relationship to psychosocial and academic functioning.

Pearson correlations were calculated for all of the variables before conducting linear regression analyses. The criterion adjustment variables included: PHQ-9 total score, GAD-7 total score, SACQ – Social Adjustment Subscale, current GPA, and SACQ – Academic Adjustment Subscale. Linear regression analyses were then conducted to determine the relationship of substance use to the five criterion variables. Regression analyses where the model was significant controlled for the following covariates: current age, sex, current year in college. Specifically, each regression analysis was run without covariates initially to determine if the model was significant. If the model was not significant, no covariates were added. However, regression models that were significant were rerun again with previously mentioned covariates to determine if they would remain significant.

It was hypothesized that higher levels of current substance use would predict more psychosocial and academic functioning problems (*Aim* 4, Hyp 1a,b and Hyp 2a,b). To help clarify later regression analyses, the direction of the values of beta weights associated with how the controlling or covariate variables were coded are outlined next. In all regression analyses, POSITIVE beta-weights were associated with the following covariate values and indicated: higher current age, being female, and higher current year in college. NEGATIVE beta-weights associated with the covariate values indicated the following: younger current age, being male, and lower current year in college. Each section presents tables that include results of linear regression and those of logistic regression for the eight criterion variables previously mentioned. For clarity, in each table analyses that utilized covariates are indicated with a "#" next to the model. This is also noted beneath each table if there were covariates used in any of the analyses in that table.

Substance Use in Relation to Psychosocial/Academic Functioning

Current Alcohol Consumption in Relation to Psychosocial/Academic Functioning. In terms of alcohol use, it was hypothesized that more current alcohol consumption would be related to more psychosocial and academic functioning difficulties (*Aim* 4, Hyp 1 and 2). Contrary to the hypotheses, there were no significant correlations between current alcohol consumption and depression symptoms on the PHQ-9 (r = -.143, p > .05) and anxiety on the GAD-7 (r = -.012, p > .05). Further, there was no correlation between current alcohol consumption and the SACQ – Social Adjustment Subscale ($r = .203$, $p > .05$). In addition, current alcohol consumption was not correlated with current college GPA ($r = .169$, $p > .05$) or with the SACQ – Academic Adjustment Subscale ($r = -.008$, $p > .05$).

Next, regression analyses were used to examine the relationship of current alcohol consumption to psychosocial and academic functioning. Results of linear regression analyses mirrored those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that current alcohol consumption did not predict current depression symptoms on the PHQ-9, $r^2 = .021$ (adjusted $r^2 = .005$), F (1, 64) = 1.346, $p > .05$. Further, current alcohol consumption did not predict current anxiety symptoms on the GAD-7, $r^2 = .000$ (adjusted $r^2 = -.015$), F (1, 64) = .010, $p > .05$. Moreover, linear regression analysis revealed that current alcohol consumption did not predict social adjustment problems on the SACQ, $r^2 = .041$ (adjusted $r^2 = .026$), F (1, 64) = 2.759, $p > .05$. Similarly, linear regression analysis revealed that current alcohol consumption did not predict current GPA, $r^2 = .029$ (adjusted $r^2 = .009$), F (1, 49) = 1.438, $p > .05$. Finally, linear regression analysis revealed that current alcohol consumption did not predict academic adjustment problems on the SACQ, $r^2 = .000$ (adjusted $r^2 = -.016$), F (1, 64) = .004, $p > .05$. *Table 65* displays detailed results of the linear regression analyses.

Table 65. Linear Regression, Current Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig

PHQ-9 (Depression)	-.143	.009	-1.160	*p* = .250
GAD-7 (Anxiety)	-.012	.009	-.099	*p* = .921
SACQ – Social Adjustment	.203	.019	1.661	*p* = .102
GPA	.169	.001	1.199	*p* = .236
SACQ – Academic Adjustment	-.008	.016	-.063	*p* = .950

In summary, current alcohol consumption was surprisingly not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, current alcohol consumption did not predict any of the psychosocial and academic functioning variables.

Binge Drinking Status in Relation to Psychosocial/Academic Functioning. Next, binge drinking status in relation to psychosocial and academic functioning was assessed. It was hypothesized that classification as a binge drinker would predict more psychosocial and academic functioning difficulties (*Aim 4,* Hyp 1 and 2). Findings were generally consistent with those of current alcohol consumption in that classification as a binge drinker was not correlated with depression symptoms on the PHQ-9 (r = -.183, p > .05) and anxiety on the GAD-7 (r = -.118, p > .05). Interestingly, there was a significant positive correlation between binge drinking status and the SACQ – Social Adjustment Subscale (r = .308, p < .05); however, this was in the opposite direction than expected. Those who reported binge drinking also reported being more socially adjusted to college. In addition, binge drinking status was not correlated with current college GPA (r = -.092, p > .05) or with the SACQ – Academic Adjustment Subscale (r = -.141, p > .05).

Next, regression analyses were used to examine the relationship of binge drinking status to psychosocial and academic functioning, controlling for demographics. Results of linear regression analyses were generally similar to those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that binge drinking did not predict current depression symptoms on the PHQ-9, $r^2 = .033$ (adjusted $r^2 = .018$), F (1, 64) = 2.214, $p > .05$. Further, binge drinking status did not predict current anxiety symptoms on the GAD-7, $r^2 = .014$ (adjusted $r^2 = -.001$), F (1, 64) = .910, $p > .05$. Interestingly, linear regression analysis revealed that classification as a binge drinker did predict social adjustment problems on the SACQ; however, once controlling for age, sex, and current year in college this was no longer significant, $r^2 = .124$ (adjusted $r^2 = .067$), F (1, 64) = 2.163, $p > .05$. In terms of academic functioning, linear regression analysis revealed that binge drinking status did not predict current GPA, $r^2 = .008$ (adjusted $r^2 = -.012$), F (1, 49) = .414, $p > .05$. Finally, linear regression analysis revealed that binge drinking status did not predict academic adjustment problems on the SACQ, $r^2 = .02$ (adjusted $r^2 = .005$), F (1, 64) = 1.307, $p > .05$. *Table 69* displays detailed results of the linear regression analyses.

Table 66. Linear Regression, Binge Drinking on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.183	1.648	-1.488	$p = .142$
GAD-7 (Anxiety)	-.118	1.652	-.954	$p = .344$

# SACQ – Social Adjustment	.294	3.666	2.318	$p = .024$
GPA	-.092	.241	-.644	$p = .523$
SACQ – Academic Adjustment	-.141	2.996	-1.143	$p = .257$

: Controlled for age, sex, and current year in college.
Note: Some of the individual statistics in the table will be displayed as significant, even if the regression model was not significant as discussed above. For ease of interpretation these will not be notated with an asterisk. Only significant statistics that the regression model was significant for will be notated with an asterisk.

In summary, binge drinking status was not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, binge drinking status did not predict any of the psychosocial and academic functioning variables.

Current Marijuana Use in Relation to Psychosocial/Academic Functioning. In terms of marijuana use, it was hypothesized that more current marijuana use would be related to more psychosocial and academic functioning difficulties (*Aim* 4, Hyp 1 and 2). Contrary to the hypotheses, results showed no correlations between current marijuana use and depression symptoms on the PHQ-9 ($r = .024$, $p > .05$) and anxiety on the GAD-7 ($r = .015$, $p > .05$). Further, there was no correlation between current marijuana use and the SACQ – Social Adjustment Subscale ($r = .109$, $p > .05$). In addition, current marijuana use was not correlated with current college GPA ($r = -.101$, $p > .05$) or with the SACQ – Academic Adjustment Subscale ($r = -.108$, $p > .05$).

Next, regression analyses were used to examine the relationship of current marijuana use to psychosocial and academic functioning, controlling for demographics. Results of linear regression analyses mirrored those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that current marijuana use did not predict current depression symptoms on the

PHQ-9, $r^2 = .000$ (adjusted $r^2 = -.016$), $F(1, 63) = .010$, $p > .05$. Further, current marijuana use did not predict current anxiety symptoms on the GAD-7, $r^2 = .000$ (adjusted $r^2 = -.016$), $F(1, 63) = .000$, $p > .05$. Moreover, linear regression analysis revealed that current marijuana use did not predict social adjustment problems on the SACQ, $r^2 = .016$ (adjusted $r^2 = .001$), $F(1, 63) = 1.057$, $p > .05$. Similarly, linear regression analysis revealed that current marijuana use did not predict current GPA, $r^2 = .018$ (adjusted $r^2 = -.002$), $F(1, 49) = 1.438$, $p > .05$. Finally, linear regression analysis revealed that current marijuana use did not predict academic adjustment problems on the SACQ, $r^2 = .023$ (adjusted $r^2 = .008$), $F(1, 63) = 1.515$, $p > .05$. *Table 67* displays detailed results of the linear regression analyses.

Table 67. Linear Regression, Current Marijuana use on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.013	.415	.101	$p = .920$
GAD-7 (Anxiety)	.000	.412	.000	$p = 1.000$
SACQ – Social Adjustment	.128	.886	1.028	$p = .308$
GPA	-.135	.062	-.954	$p = .345$
SACQ – Academic Adjustment	-.153	.741	-1.231	$p = .223$

In summary, current marijuana use was not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, current marijuana use did not predict any of the psychosocial and academic functioning variables.

Regular Marijuana User in Relation to Psychosocial/Academic Functioning. Regular marijuana users were classified as participants who reported using marijuana at least once per week in the last 3 months. It was hypothesized that classification as a regular marijuana user would be related to more psychosocial and academic functioning difficulties (*Aim* 4, Hyp 1 and 2). Contrary to the hypotheses, results also showed no correlations between classification as a regular marijuana user and depression symptoms on the PHQ-9 (r = .011, p > .05) and anxiety on the GAD-7 (r = .028, p > .05). Further, there was no correlation between classification as a regular marijuana user and the SACQ – Social Adjustment Subscale (r = .082, p > .05). In addition, classification as a regular marijuana user was not correlated with current college GPA (r = -.112, p > .05) or with the SACQ – Academic Adjustment Subscale (r = -.118, p > .05).

Next, regression analyses were used to examine the relationship of classification as a regular marijuana user to psychosocial and academic functioning. Results of linear regression analyses mirrored those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that classification as a regular marijuana user did not predict current depression symptoms on the PHQ-9, r^2 = .000 (adjusted r^2 = -.016), F (1, 64) = .007, p > .05. Further, classification as a regular marijuana user did not predict current anxiety symptoms on the GAD-7, r^2 = .001 (adjusted r^2 = -.015), F (1, 64) = .049, p > .05. Moreover, linear regression analysis revealed that classification as a regular marijuana user did not predict social adjustment problems on the SACQ, r^2 = .007 (adjusted r^2 = -.009), F (1, 64) = .436, p > .05. Similarly, linear regression analysis revealed that classification as a regular marijuana user did not predict current GPA, r^2 = .013 (adjusted r^2 = -.008), F (1,

49) = .627, $p > .05$. Finally, linear regression analysis revealed that classification as a regular marijuana user did not predict academic adjustment problems on the SACQ, r^2 = .014 (adjusted r^2 = -.001), F (1, 64) = .910, $p > .05$. *Table 68* displays detailed results of the linear regression analyses.

Table 68. Linear Regression, classification as a regular marijuana user on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.011	1.661	.086	p = .932
GAD-7 (Anxiety)	.028	1.647	.220	p = .826
SACQ – Social Adjustment	.082	3.563	.660	p = .512
GPA	-.112	.253	-.792	p = .432
SACQ – Academic Adjustment	-.118	2.976	-.954	p = .344

In summary, classification as a regular marijuana user was not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, classification as a regular marijuana user did not predict any of the psychosocial and academic functioning variables.

Other Illicit Drug Use in Relation to Psychosocial/Academic Functioning. Next, current Other Illicit drug use (i.e., using an illicit substance other than alcohol, marijuana, or prescription stimulant medication in the last 3 months) in relation to psychosocial and academic functioning was examined. It was hypothesized that current other illicit drug use would be related to more psychosocial and academic functioning difficulties (*Aim* 4, Hyp 1 and 2). Contrary to the hypotheses, results showed no correlations between current Other Illicit drug use and depression symptoms on the PHQ-9 (r = -.015, p > .05) and anxiety on the GAD-7 (r = -.101, p > .05). Further, there was no correlation between current Other Illicit drug use and the SACQ – Social Adjustment Subscale (r = .071, p > .05). In addition, current Other Illicit drug use was not correlated with current college GPA (r = -.060, p > .05) or with the SACQ – Academic Adjustment Subscale (r = -.076, p > .05).

Next, regression analyses were used to examine the relationship of current Other Illicit drug use to psychosocial and academic functioning. Results of linear regression analyses mirrored those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that current Other Illicit drug use did not predict current depression symptoms on the PHQ-9, r^2 = .000 (adjusted r^2 = -.015), F (1, 64) = .014, p > .05. Further, current Other Illicit drug use did not predict current anxiety symptoms on the GAD-7, r^2 = .01 (adjusted r^2 = -.005), F (1, 64) = .658, p > .05. Moreover, linear regression analysis revealed that current Other Illicit drug use did not predict social adjustment problems on the SACQ, r^2 = .005 (adjusted r^2 = -.01), F (1, 64) = .327, p > .05. Similarly, linear regression analysis revealed that current Other Illicit drug use did not predict current GPA, r^2 = .004 (adjusted r^2 = -.017), F (1, 49) = .178, p > .05. Finally, linear regression analysis revealed that current Other Illicit drug use did not predict academic adjustment problems on the SACQ, r^2 = .006 (adjusted r^2 = -.01), F (1, 64) = .367, p > .05. *Table 69* displays detailed results of the linear regression analyses.

Table 69. Linear Regression, current Other Illicit drug use on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.015	2.009	-.119	*p* = .906
GAD-7 (Anxiety)	-.101	1.983	-.811	*p* = .420
SACQ – Social Adjustment	.071	4.313	.572	*p* = .569
GPA	-.060	.324	-.422	*p* = .675
SACQ – Academic Adjustment	-.076	3.615	-.606	*p* = .547

In summary, current Other Illicit drug use was not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, current Other Illicit drug use did not predict any of the psychosocial and academic functioning variables.

ADHD Stimulant Medication Misuse in Relation to Psychosocial/Academic Functioning. Lastly, ADHD stimulant medication misuse in relation to psychosocial and academic functioning was examined. It was hypothesized that misusing ADHD stimulant medication in the last year would be related to more psychosocial and academic functioning difficulties (*Aim* 4, Hyp 1 and 2). Contrary to the hypotheses, results showed no correlations between ADHD stimulant medication misuse and depression symptoms on the PHQ-9 (r = -.051, p > .05) and anxiety on the GAD-7 (r = -.017, p > .05). Further, there was no correlation between ADHD stimulant medication misuse and the SACQ – Social Adjustment Subscale (r = .071, p > .05). In addition, ADHD stimulant medication misuse was not correlated with current college GPA (*r* = .013, *p* > .05) or with the SACQ – Academic Adjustment Subscale (*r* = -.104, *p* > .05).

Next, regression analyses were used to examine the relationship of ADHD stimulant medication misuse to psychosocial and academic functioning. Results of linear regression analyses mirrored those of the correlational analyses. Specifically, contrary to the hypotheses (*Aim* 4, Hyp 1 and 2), linear regression analysis revealed that ADHD stimulant medication misuse did not predict current depression symptoms on the PHQ-9, $r^2 = .003$ (adjusted $r^2 = -.013$), F (1, 64) = .167, $p > .05$. Further, ADHD stimulant medication misuse did not predict current anxiety symptoms on the GAD-7, $r^2 = .000$ (adjusted $r^2 = -.015$), F (1, 64) = .018, $p > .05$. Moreover, linear regression analysis revealed that ADHD stimulant medication misuse did not predict social adjustment problems on the SACQ, $r^2 = .000$ (adjusted $r^2 = -.015$), F (1, 64) = .018, $p > .05$. Similarly, linear regression analysis revealed that ADHD stimulant medication misuse did not predict current GPA, $r^2 = .000$ (adjusted $r^2 = -.020$), F (1, 49) = .008, $p > .05$. Finally, linear regression analysis revealed that ADHD stimulant medication misuse did not predict academic adjustment problems on the SACQ, $r^2 = .011$ (adjusted $r^2 = -.005$), F (1, 64) = .699, $p > .05$. *Table 70* displays detailed results of the linear regression analyses.

Table 70. Linear Regression, ADHD stimulant medication misuse on Psychosocial and Academic Functioning

Criterion Variables	Standardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.051	1.862	.408	*p* = .684

GAD-7 (Anxiety)	.017	1.849	.132	*p* = .895
SACQ – Social Adjustment	-.017	4.012	-.136	*p* = .892
GPA	-.013	.271	-.091	*p* = .928
SACQ – Academic Adjustment	.104	3.346	.836	*p* = .406

As with the prior analyses, ADHD stimulant medication misuse was not a good predictor of psychosocial and academic functioning difficulties in the sample. In fact, ADHD stimulant medication misuse did not predict any of the psychosocial and academic functioning variables.

In summary, the various substance abuse variables were not predictive of the psychosocial/academic adjustment measures used in this study. None of the use variables were related to reported anxiety or depression scores nor did they predict GPA or measures of academic or social adjustment to college. Recall that substance use variables were related to associated negative consequences but largely independent of these psychosocial outcomes, which were more related to ADHD symptoms. However, of note, more drug-related consequences on the SIP-D was related to more current symptoms of depression symptoms on the PHQ-9 ($r = .307$, $p < .01$) and more academic adjustment difficulties on the SACQ ($r = -.346$, $p < .05$). There were no relationships between alcohol-related negative consequences on the RAPI and psychosocial/academic functioning.

Current Substance Use as a Possible Moderator of the Relationship between ADHD Predictors and Psychosocial Adjustment

Finally, I report on exploratory moderation analyses (Hayes, 2013) examining the relationship between ADHD specific factors (i.e., ASRS, T.O.V.A., SUPPS-P, and BDEFS-CA) and psychosocial/academic functioning (i.e., PHQ-9 total score, GAD-7 total score, SACQ – Social Adjustment Subscale, current GPA, and SACQ – Academic Adjustment Subscale), with current substance use as a moderator (i.e., current alcohol consumption, binge drinking status, and current marijuana use). Classification as a regular marijuana user was excluded from these analyses due to it being highly correlated with current marijuana use ($r = .93$, $p < .001$). In addition, Other Illicit Drug use and ADHD medication misuse were also excluded from these moderation analyses. There was a low number of individuals who reported using Other Illicit drugs in the last 3 months ($N = 11$). The variable ADHD stimulant misuse was excluded as well because in all prior analysis it was not a significant predictor, decreasing its validity as a measure of current ADHD medication misuse.

These analyses were run using the PROCESS Macro and SPSS (Versions 24 and 25, Greenville, NC), using a bootstrapping technique generating 5,000 random samples with replacement from the data set. It was hypothesized that the interaction of higher levels of ADHD specific factors with more current substance use would predict more psychosocial/academic functioning difficulties. For each set of moderation analyses tables display the interaction variables for all of the criterion adjustment variables (e.g., ASRS x current alcohol consumption on PHQ, GAD, SACQ – Social, GPA, SACQ – Academic).

Due to the large number of moderation analyses conducted, only the significant analyses are reported in this section. Specifically, if a specific ADHD predictor with substance use as a moderator was significant in predicting one or more psychosocial and/or academic outcomes than all of these analyses are reported in this section. If there were no significant interactions for an ADHD specific variable they are not reported in this section. However, *Appendix B* displays extended results of all of the non-significant moderation analyses.

Interaction of Impulsivity and Current Alcohol Consumption. First, the interaction of the SUPPS-P and current alcohol consumption on psychosocial and academic functioning was examined. Positive urgency (impulsivity) moderation findings are reported first, followed by negative urgency (emotion dysregulation) results. It was hypothesized that higher positive urgency scores would interact with more current alcohol use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

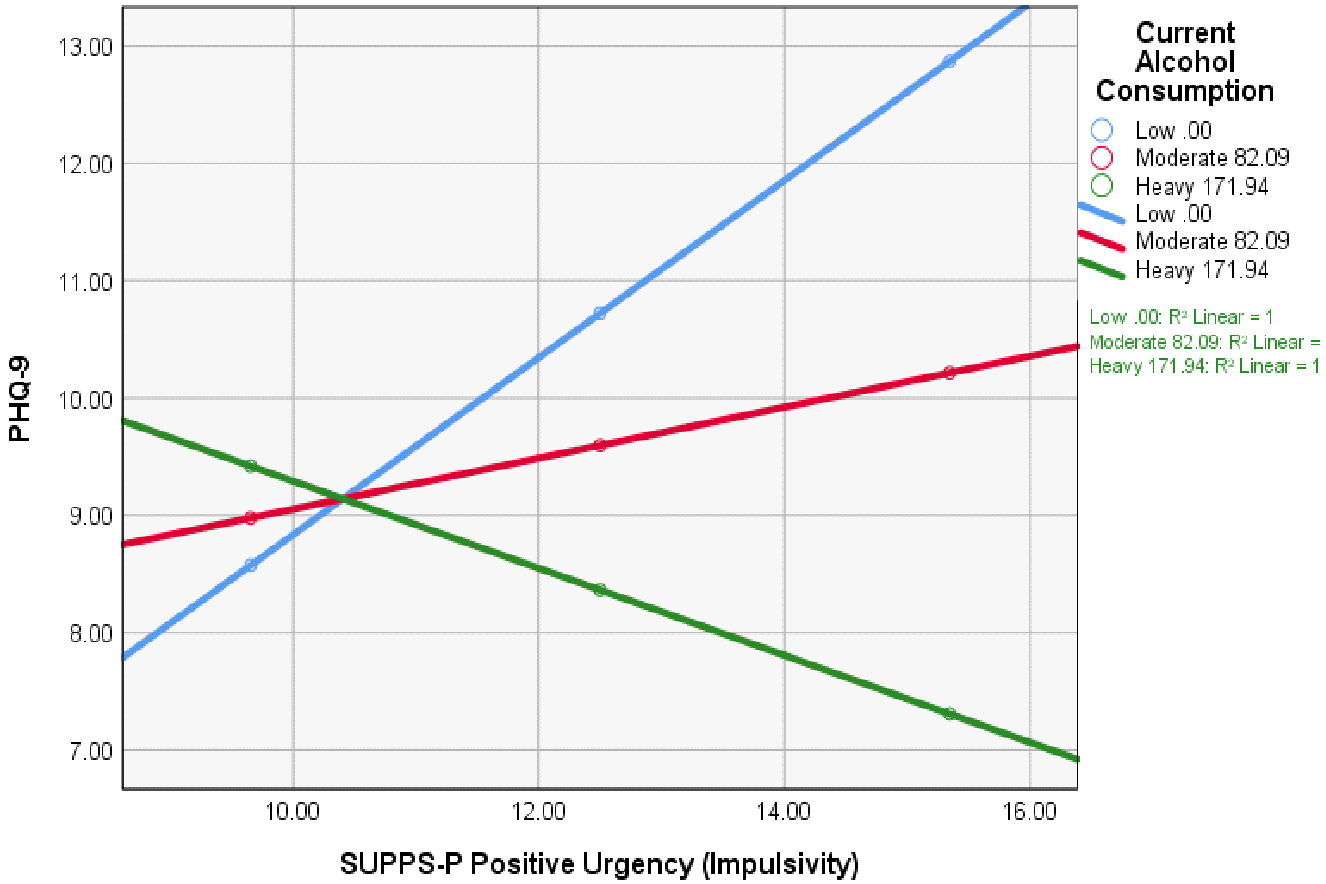
Using the PROCESS Macro, moderation findings revealed a significant overall model of positive urgency, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 3.934, $p < .01$, $R^2 = .346$. Upon further review, the interaction of positive urgency (impulsivity) and current alcohol consumption was significant in predicting depression symptoms on the PHQ-9. Of note, being female and having a higher reported history of conduct problems emerged as significant covariates in the model ($p = .007$; $p = .026$), respectively. Upon post hoc analyses of indirect effects, findings revealed a significant indirect effect of low current alcohol consumption and the PHQ-9, $b = .375$, t = 3.553, $p = .001$, such that higher impulsivity predicted lower depression symptoms, but only at low levels of alcohol use. There were no significant indirect effects for moderate or heavy users. This interaction effect is displayed visually in *Figure 3*. In addition, moderation findings did not reveal a significant overall model of positive urgency, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 2.00, $p > .05$, R^2= .195. Moreover, moderation findings did not reveal a significant overall model of positive urgency, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.209, $p > .05$, R^2= .127. Similarly, moderation findings did not reveal a significant overall model of positive urgency, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.792, $p > .05$, R^2= .226. Lastly, moderation findings did not reveal a significant overall model of positive urgency, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .836, $p > .05$, R^2= .092. Specific results of moderation analyses with the SUPPS-P positive urgency subscale can be found in *Table 71* below.

Table 71. Moderation, SUPPS-P Positive Urgency and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.007	.003	-2.270	p = .027*
GAD-7 (Anxiety)	-.006	.003	-1.773	p = .081
SACQ – Social Adjustment	.008	.007	1.197	p = .236
GPA	-.045	.086	-.517	p = .608
SACQ – Academic Adjustment	1.699	1.142	1.487	p = .143

* $p < .05$.

Figure 3. Interaction of SUPPS-P Positive Urgency and Alcohol Consumption on PHQ-9



In summary, there were minimal findings when testing the interaction of the SUPPS-P positive urgency subscale and current alcohol consumption on psychosocial and academic functioning within this sample. However, there was a significant interaction of higher positive urgency and more current alcohol use predicting less depression symptoms on the PHQ-9; however, this was not in the expected direction.

Interaction of Executive Functioning Deficits and Current Alcohol Consumption. Next, the interaction of the BDEFS-CA and current alcohol consumption on psychosocial and academic functioning was examined. It was hypothesized that higher BDEFS-CA raw total scores would interact with more current alcohol use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of executive functioning deficits, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 8.186, $p < .001$, $R^2 = .497$. Contrary to the hypothesis, the interaction of higher executive functioning deficits and more current alcohol consumption was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female emerged as a significant covariate in the model ($p = .039$). In addition, moderation findings revealed a significant overall model of executive functioning deficits, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 3.744, $p < .01$, $R^2 = .311$. When examined further, the interaction of executive functioning deficits and alcohol consumption was not significant in predicting the GAD-7. Moreover, moderation findings revealed a significant overall model of executive functioning deficits, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 3.655, $p < .01$, $R^2 = .306$. However, upon further review, the interaction of executive functioning deficits and alcohol use was not significant in predicting social adjustment on the SACQ.

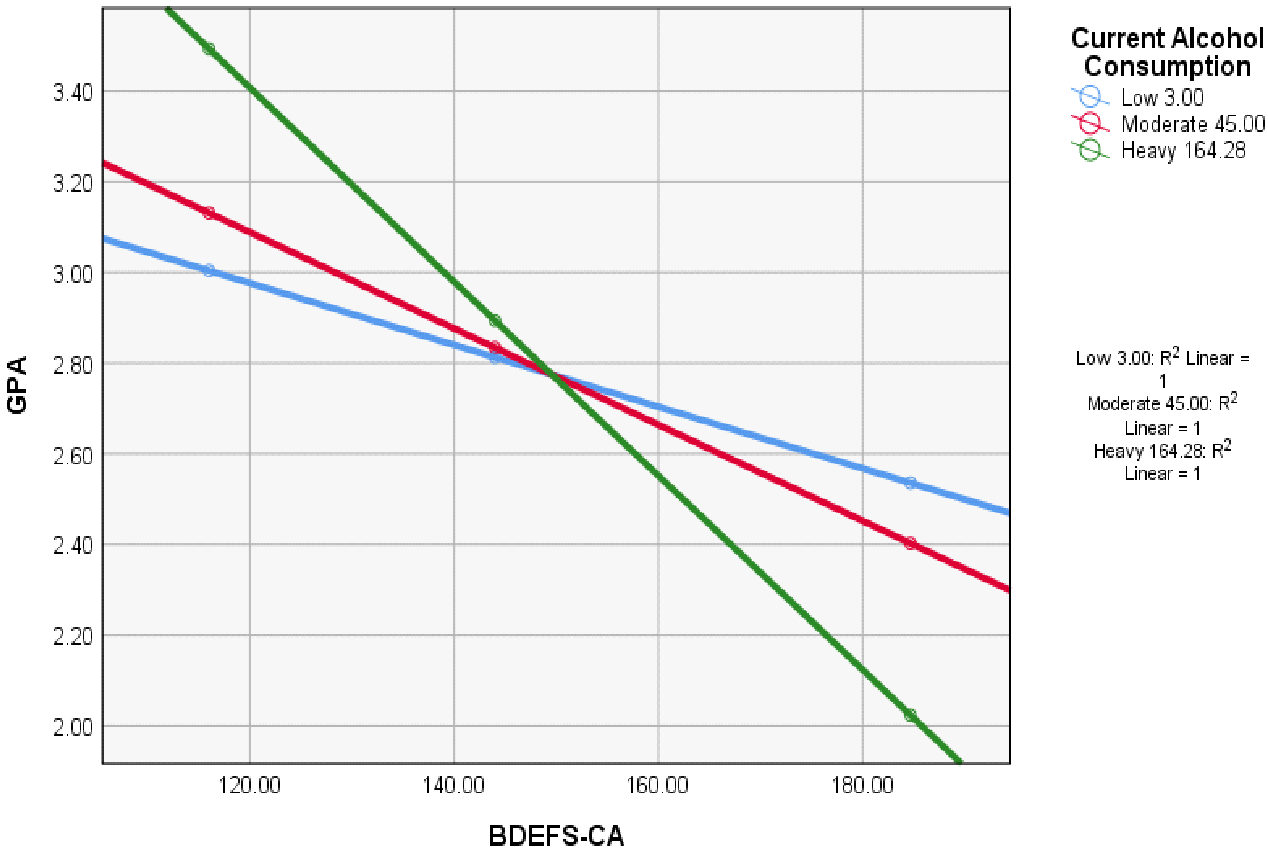
As hypothesized, moderation findings revealed a significant overall model of executive functioning deficits, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 4.955, $p < .001$, $R^2 = .447$. Upon further examination, the interaction of higher executive functioning deficits and more current alcohol consumption was significant in predicting lower current GPA. Of note, higher year in college and greater history of conduct problems emerged as significant covariates (p = .004; p = .032), respectively. Upon post hoc analyses of indirect effects, findings revealed significant indirect effects of low, moderate, and heavy current alcohol consumption and GPA, b = -.007, t = -2.273, p = .028; b = -.011, t = -4.190, p = .000; b = -.021, t = -3.860, p = .000, respectively, such that greater executive functioning deficits predicted lower GPA for all levels of current alcohol use, but the effect was greater for the heaviest users. This interaction effect is displayed visually in *Figure 4*. Lastly, moderation findings revealed a significant overall model of executive functioning deficits, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 5.083, $p < .001$, R^2= .38; however, the interaction was non-significant. Specific results of moderation analyses with the BDEFS-CA can be found in *Table 72* below.

Table 72. Moderation, Executive functioning deficits and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.0003	.0002	-1.105	p = .274
GAD-7 (Anxiety)	-.0004	.0003	-1.319	p = 193.
SACQ – Social Adjustment	.001	.001	.800	p = .427
GPA	-.0001	.000	-2.229	p = .031*
SACQ – Academic Adjustment	-.0004	.001	-.719	p = .475

* $p < .05$.

Figure 4. Interaction of BDEFS-CA and Alcohol Consumption on GPA.



In summary, there were minimal findings when testing the interaction of executive functioning deficits on the BDEFS-CA and current alcohol consumption on psychosocial and academic functioning within this sample. However, the interaction of higher executive functioning deficits on the BDEFS-CA and more current alcohol use did significantly predict lower current GPA in this sample.

Interaction of ADHD Specific Predictors and Current Alcohol Consumption

Summary of Findings

Overall, numerous moderation analyses were conducted to determine the influence of current alcohol consumption on the relationship between ADHD specific factors and psychosocial/academic functioning. In summary, there were minimal moderation findings even though several of the overall moderation models were significant. Specifically, there were no significant interaction terms between severity of ADHD symptoms (i.e., ASRS and T.O.V.A. variables) and alcohol use when predicting psychosocial and academic functioning.

Interestingly, the interaction of higher impulsivity (i.e., SUPPS-P, Positive Urgency Subscale) and more current alcohol use predicting less depression symptoms on the PHQ-9 was significant; however, this was not in the expected direction. Further, there were no significant interaction effects when examining emotion dysregulation (i.e., SUPPS-P, Negative Urgency Subscale). Lastly, executive functioning deficits (BDEFS-CA) and alcohol use moderation analyses were largely not predictive. However, as hypothesized, the interaction of higher executive functioning deficits on the BDEFS-CA and more current alcohol use, did significantly predict lower current GPA in this sample. Overall, interactions between the ADHD specific predictors and current alcohol use were not good at predicting psychosocial and academic functioning difficulties in this sample of all ADHD college students.

Interaction of Executive Functioning Deficits and Binge Drinking Status. Next, the interaction of the BDEFS-CA and binge drinking status on psychosocial and academic functioning was examined. It was hypothesized that higher BDEFS-CA raw total scores would interact with binge drinking status to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of executive functioning deficits, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 7.92, $p < .001$, $R^2 = .489$. Contrary to the hypothesis, the interaction of higher executive functioning deficits and more binge drinking status was not significant in predicting lower depression symptoms on the PHQ-9. In addition, moderation findings revealed a significant overall model of executive functioning deficits, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 3.51, $p < .01$, $R^2 = .298$. When examined further, the interaction of executive functioning deficits and binge drinking status was not significant in predicting the GAD-7. Moreover, moderation findings revealed a significant overall model of executive functioning deficits, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 4.553, $p < .001$, $R^2 = .355$. However, upon further review, the interaction of executive functioning deficits and binge drinking status was not significant in predicting social adjustment on the SACQ.

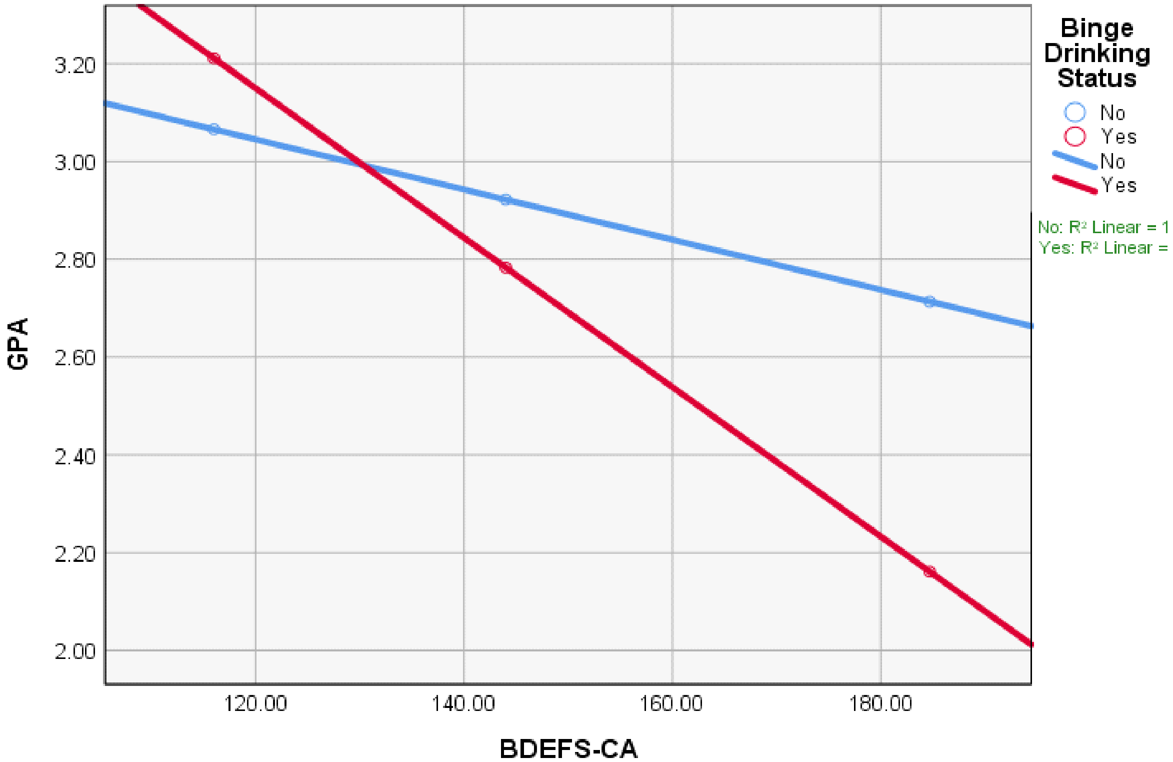
As hypothesized, moderation findings revealed a significant overall model of executive functioning deficits, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 4.946, $p < .001$, $R^2 = .446$. Upon further examination, the interaction of higher executive functioning deficits and binge drinking status was significant in predicting lower current GPA. Of note, higher year in college and greater history of conduct problems emerged as significant covariates ($p = .005$; $p =$ 004), respectively. Upon post hoc analysis of indirect effects, findings revealed a significant indirect effect of classification as a binge drinker and current GPA, $b = .375$, t = 3.553, $p = .001$, such that higher executive functioning deficits predicted lower GPA, but only for those classified as binge drinkers. There was not a significant indirect effect for non-binge drinking status. This interaction effect is displayed visually in *Figure 5*. Higher year in college and greater history of conduct problems emerged as significant covariates (p = .004; p = .032), respectively. Lastly, moderation findings revealed a significant overall model but no interaction effect of executive functioning deficits, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 6.088, p < .001, R^2= .424. Specific results of moderation analyses with the BDEFS-CA (executive functioning deficits) can be found in *Table 73* below.

Table 73. Moderation, Executive Functioning Deficits and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.004	.035	-.125	p = .901
GAD-7 (Anxiety)	-.034	.041	-.819	p = .416
SACQ – Social Adjustment	-.013	.086	-.148	p = .883
GPA	-.010	.005	-2.032	p = .048*
SACQ – Academic Adjustment	-.110	.068	-1.625	p = .110

* p < .05

Figure 5. Interaction of BDEFS-CA and Binge Drinking Status on GPA.



In summary, there were minimal findings when testing the interaction of executive functioning deficits on the BDEFS-CA and binge drinking status on psychosocial and academic functioning within this sample. However, the interaction of higher executive functioning deficits on the BDEFS-CA binge drinking status did significantly predict lower current GPA in this sample.

Interaction of ADHD Specific Predictors and Binge Drinking Status Summary of Findings

Overall, numerous moderation analyses were conducted to determine the influence of binge drinking status on the relationship between ADHD specific factors and psychosocial/academic functioning. In summary, there were minimal moderation findings even though several of the overall moderation models were significant. Specifically, there were no significant interaction terms between severity of ADHD symptoms (i.e., ASRS and T.O.V.A. variables) and binge drinking status when predicting psychosocial and academic functioning. In addition, there were no significant interaction effects when examining impulsivity (i.e., SUPPS-P, Positive Urgency Subscale). Further, there were no significant interaction effects when examining emotion dysregulation (i.e., SUPPS-P, Negative Urgency Subscale). Lastly, executive functioning deficits and binge drinking status moderation analyses were largely not predictive. However, as hypothesized, the interaction of higher executive functioning deficits on the BDEFS-CA and binge drinking status, did significantly predict lower current GPA in this sample. Overall, interactions between the ADHD specific predictors and binge drinking status were not good at predicting psychosocial and academic functioning difficulties in this sample of all ADHD college students.

Interaction of T.O.V.A. Variables and Current Marijuana Use. Next, the interaction of the T.O.V.A. variables (i.e., RTV, RT, CE, and OE) and current marijuana use on psychosocial and academic functioning was assessed. It was hypothesized that greater impairment on the T.O.V.A. variables in combination with more current marijuana use would predict more problematic psychosocial and academic functioning in the sample. First, I report on the T.O.V.A. RTV (consistency), followed by RT (speed), CE (impulsivity), and OE (focus and vigilance). It was hypothesized that lower standard scores on the T.O.V.A. variables (i.e., less RTV, slower RT, more CE, and more OE) would interact with current marijuana use to predict more psychosocial and academic functioning difficulties (*Aim 4*, Hyp 3a and 3b).

The T.O.V.A. CE (impulsivity) was examined using the PROCESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. CE, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.922, p < .05, R^2= .261. However, the interaction of the T.O.V.A. CE and current marijuana use was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .002). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.984, p > .05, R^2= .193. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.493, p > .05, R^2= .153. Moderation findings revealed a significant overall model of the T.O.V.A. CE, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 3.270, p > .05, R^2= .347. Upon further examination, the interaction of lower T.O.V.A. CE (higher impulsivity) and more current marijuana use predicted lower overall GPA. Upon post hoc analyses of indirect effects, findings revealed a significant indirect effect of heavy current marijuana use and GPA, b = 7.00, t = 3.104, p = .003, such that higher impulsivity predicted lower GPA, but only at high levels of marijuana use. There were no significant indirect effects for moderate and low use. This interaction effect is displayed visually in *Figure 6.* Of note, higher year in college emerged as a significant covariate (p = .039). Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 1.601, $p > .05$, R^2= .162. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 74* below.

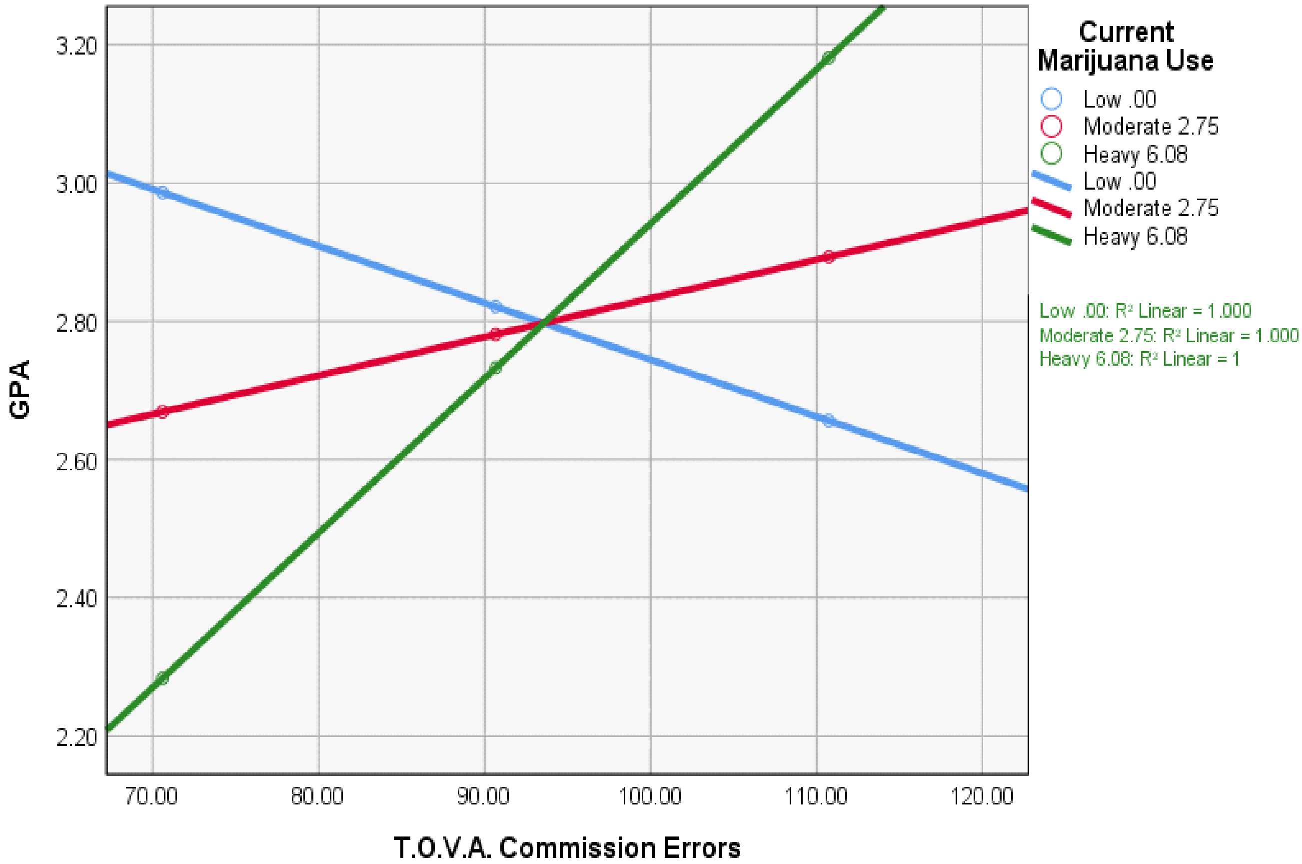
Table 74. Moderation, T.O.V.A. CE and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.016	.011	-1.367	p = .177
GAD-7 (Anxiety)	-.020	.012	-1.660	p = .102
SACQ – Social Adjustment	.066	.026	2.530	p = .014
GPA	.005	.002	3.176	p = .003**
SACQ – Academic Adjustment	.064	.022	2.914	p = .005

** $p < .01$

Note: Some of the individual statistics in the table will be displayed as significant, even if the regression model was not significant as discussed above. For ease of interpretation these will not be notated with an asterisk. Only significant statistics that the regression model was significant for will be notated with an asterisk.

Figure 6. Interaction of T.O.V.A. CE and Current Marijuana Use on GPA.



Lastly, the T.O.V.A. OE (Focus and Vigilance) was examined using the PROOESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. OE, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.59, p < .05, R^2= .238. However, the interaction of the T.O.V.A. OE and current marijuana use was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .003), with older current age approaching significance (p = .069). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.477, $p > .05$, $R^2 = .151$. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) =.571, $p > .05$, $R^2 = .064$.

In terms of academic functioning, moderation findings revealed a significant overall model of the T.O.V.A. OE, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 3.029, $p < .01$, $R^2 = .330$. Upon further examination, the interaction of lower T.O.V.A. OE (difficulties with focus and vigilance) and more current marijuana use was significant in predicting lower current GPA. Upon post hoc analysis of indirect effects, findings revealed a significant indirect effect of greater marijuana use (heavy use) and GPA, b = .029, t = 2.976, p = .005, such that greater focus/vigilance difficulties predicted lower GPA, but only at high levels of marijuana use. There were no indirect effects for moderate or low use. This interaction is visually displayed in *Figure 7*. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .346, $p > .05$, $R^2 = .040$. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 75* below.

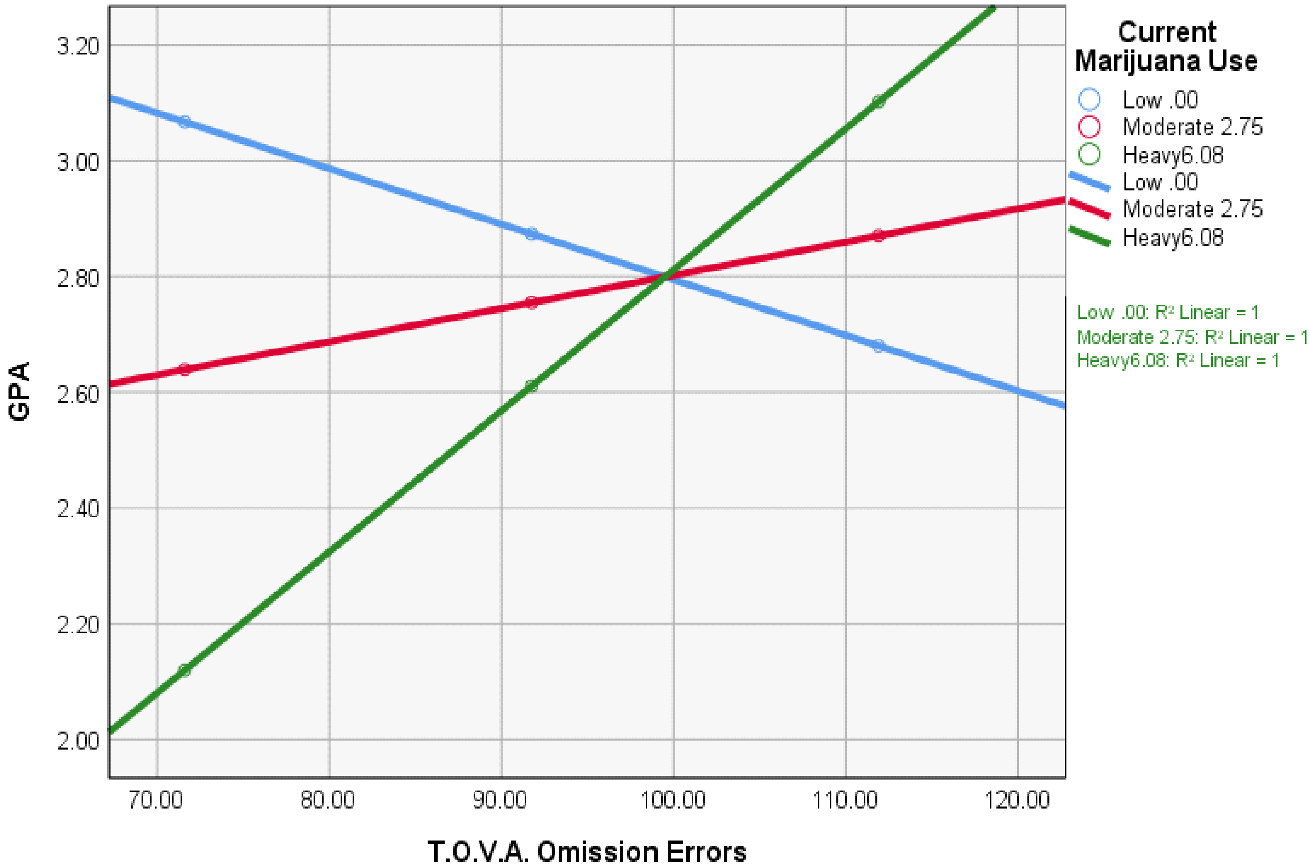
Table 75. Moderation, T.O.V.A. OE and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	t	Sig
PHQ-9 (Depression)	-.005	.010	-.494	p = .623

GAD-7 (Anxiety)	-.002	.011	-.166	*p* = .869
SACQ – Social Adjustment	.014	.025	.582	*p* = .563
GPA	.006	.002	2.995	*p* = .005**
SACQ – Academic Adjustment	.008	.021	.379	*p* = .706

** $p < .01$

Figure 7. Interaction of T.O.V.A. OE and Current Marijuana Use



In summary, there were few significant findings when testing the interaction of the T.O.V.A. variables and current marijuana use on psychosocial and academic functioning within this sample. T.O.V.A. CE (impulsivity) and OE (focus and vigilance) interacting with more current marijuana use did predict lower current GPAs in this sample.

Interaction of Executive Functioning Deficits and Current marijuana use. Next, the interaction of the BDEFS-CA and current marijuana use on psychosocial and academic functioning was examined. It was hypothesized that higher BDEFS-CA raw total scores would interact with current marijuana use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of executive functioning deficits, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 7.768, $p < .001$, $R^2 = .484$. Contrary to the hypothesis, the interaction of higher executive functioning deficits and more current marijuana use was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female approached significance as a covariate ($p = .055$). In addition, moderation findings revealed a significant overall model of executive functioning deficits, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 3.393, $p < .01$, $R^2 = .291$. When examined further, the interaction of executive functioning deficits and current marijuana use was not significant in predicting the GAD-7. Moreover, moderation findings revealed a significant overall model of executive functioning deficits, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 3.334, $p < .01$, $R^2 = .287$. However, upon further review, the interaction of executive functioning deficits and current marijuana use was not significant in predicting social adjustment on the SACQ.

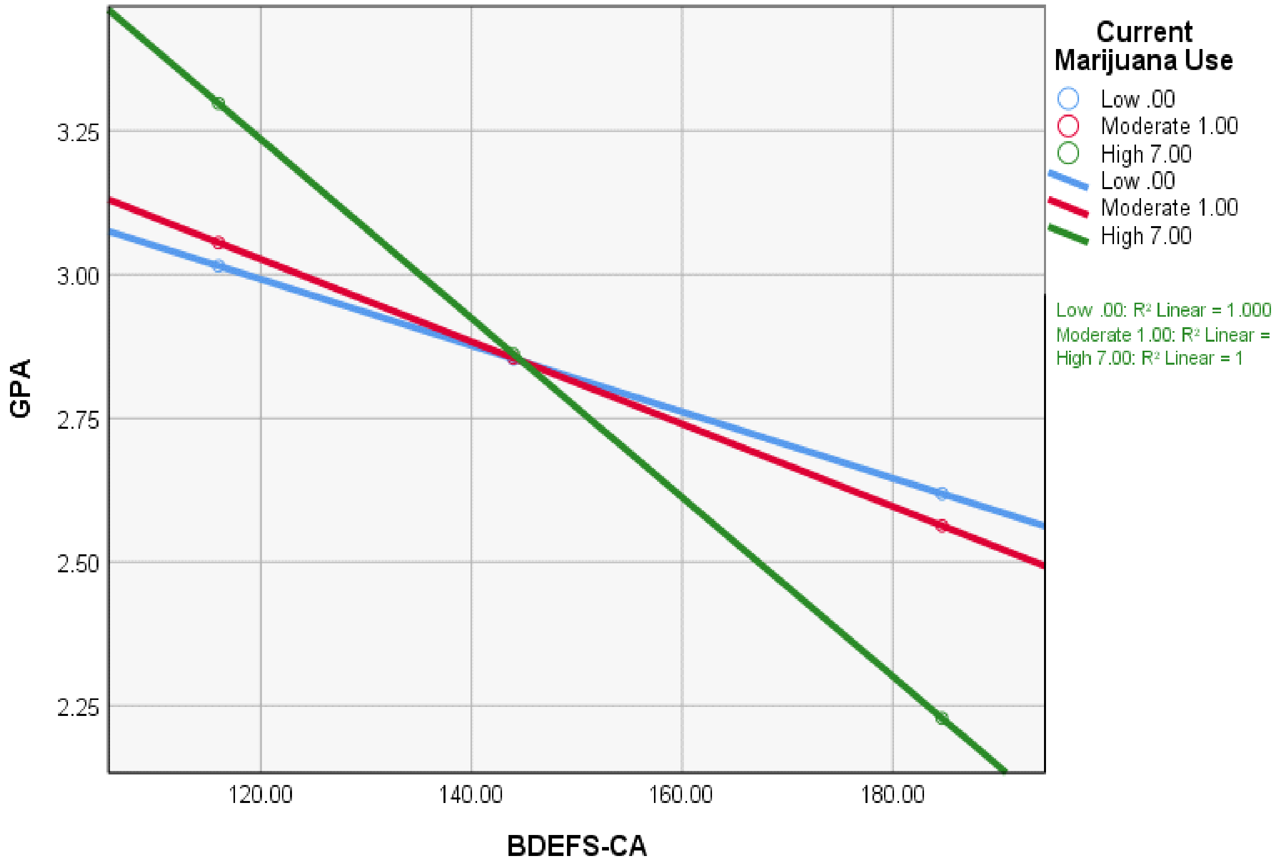
As hypothesized, moderation findings revealed a significant overall model of executive functioning deficits, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 4.779, $p < .001$, $R^2 = .438$. Upon further examination, the interaction of higher executive functioning deficits and more current marijuana use was significant in predicting lower current GPA. Of note, higher year in college and greater history of conduct problems emerged as significant covariates (p = .017; p = .028), respectively. Upon post hoc analyses of indirect effects, findings revealed significant indirect effects of moderate, b = -.007, t = -2.310, p = .021, and heavy, b = -.016, t = -4.213, p = .000, current marijuana use and GPA, such that higher executive functioning deficits predicted lower GPA, but only at moderate and heavy levels of marijuana use. There were no indirect effects for low use. This interaction effect is displayed visually in *Figure 8*. Lastly, moderation findings revealed a significant overall model of executive functioning deficits, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 5.233, $p < .001$, R^2= .387. Specific results of moderation analyses with the BDEFS-CA (executive functioning deficits) can be found in *Table 76* below.

Table 76. Moderation, Executive functioning deficits and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.001	.005	.318	p = .752
GAD-7 (Anxiety)	-.002	.005	-.411	p = .683
SACQ – Social Adjustment	-.001	.011	-.063	p = .950
GPA	-.001	.001	-2.028	p = .049*
SACQ – Academic Adjustment	-.009	.009	-1.047	p = .300

* $p < .05$

Figure 8. Interaction of BDEFS-CA and Current Marijuana Use



In summary, there were minimal findings when testing the interaction of executive functioning deficits on the BDEFS-CA and current marijuana use on psychosocial and academic functioning within this sample. However, the interaction of higher executive functioning deficits on the BDEFS-CA and more current marijuana use did significantly predict lower current GPA in this sample.

Summary of Findings: Interaction of ADHD Specific Predictors and Current Marijuana Use

Overall, numerous moderation analyses were conducted to determine the influence of current marijuana use on the relationship between ADHD specific factors and psychosocial/academic functioning. In summary, there were minimal moderation findings even though several of the overall moderation models were significant. There were a few findings with interactions predicting GPA in this sample. Specifically, there were no significant interaction terms between self-reported severity of ADHD symptoms (i.e., ASRS) and current marijuana use when predicting psychosocial and academic functioning. However, the behavioral performance measure of ADHD impairment with current marijuana use did have some predictive utility. Specifically, the interaction of lower CE (i.e., greater impulsivity) and OE (i.e., more difficulty with focus and vigilance) on the T.O.V.A. significantly predicted lower current GPA within this sample.

In addition, there were no significant interaction effects when examining impulsivity (i.e., SUPPS-P, Positive Urgency Subscale). Further, there were no significant interaction effects when examining emotion dysregulation (i.e., SUPPS-P, Negative Urgency Subscale). Lastly, executive functioning deficits and current marijuana use moderation analyses were largely not predictive. However, as hypothesized, the interaction of higher executive functioning deficits on the BDEFS-CA and more current marijuana use, did significantly predict lower current GPA in this sample. Overall, interactions between the ADHD specific predictors and current marijuana use were not good at predicting psychosocial and academic functioning difficulties in this sample of all ADHD college students, with the exception of GPA.

Overall Summary of Interaction Findings

Overall, various moderation analyses were conducted to determine the influence of substance use variables (i.e., current alcohol use, binge drinking status, and current marijuana use) on the relationship between ADHD specific factors and psychosocial/academic functioning. In summary, there were minimal moderation findings even though several of the overall moderation models were significant. In terms of current alcohol use, the interaction of higher impulsivity (i.e., SUPPS-P, Positive Urgency Subscale) and more current alcohol use predicting less depression symptoms on the PHQ-9 was significant; however, this was not in the expected direction. In addition, the interaction of higher executive functioning deficits on the BDEFS-CA and more current alcohol use, did significantly predict lower current GPA in this sample.

There was only one significant interaction effect when examining binge drinking as a moderator. Specifically, there was a significant interaction of higher executive functioning deficits on the BDEFS-CA and binge drinking status predicting lower current GPA in this sample. Finally, in terms of marijuana use, moderation analyses were generally not significant; however, there were several analyses predicting GPA that were. Specifically, the interactions of higher impulsivity (T.O.V.A. CE), more difficulties with focus and vigilance (T.O.V.A. OE), and more executive functioning deficits (BDEFS-CA), with more current marijuana use, all significantly predicted lower current GPA. In conclusion, there seems to be some utility in the interaction of ADHD specific predictors with substance use (primarily heavy marijuana use) to predict current college GPA within this sample of all ADHD college students.

Qualitative Response Findings

Participants provided responses to six qualitative questions during the study. Of note, participants were allowed to provide more than one response to each question; therefore, the following results reported in percentages sum to greater than 100.

Question 1.

Participants were asked “What do you perceive to be the major concerns or challenges for ADHD college students?”. Interrater reliability for coding this question was calculated at .85. Thirty-six participants (54.5% of the sample), reported attention difficulties in response to this question, followed by issues with studying/completing academic work (47%), time management (28.8%), independent self-management (28.8%), organization (13.6%), managing social activities (9.1%), stress/anxiety (4.5%), and asking for help (3%). The category of “other” responses was used by 22.7% of the participants including less frequent concerns (e.g., distractions in a dorm, motivation difficulties, and impulsivity).

Question 2.

Participants were asked “What do you see as their perceived needs?”. Interrater reliability for coding this question was calculated at .76. Twenty-three participants (34.8%), reported coping skills in response to this question, followed by a need for other resources (28.8%), greater teacher involvement/ support (19.7%), accommodations/ extra time (16.7%), medication (16.7%), good support system (10.6%), mentoring/ coaching (9.1%), short/ small classes (6.1%), and orientation courses (3%). Twenty-eight percent were more other idiosyncratic responses (e.g., less difficult classes, places to get up and move during class, and flexibility of class schedules).

Question 3.

Participants were asked “Are substance use risks and associated consequences different among ADHD and non-ADHD students and how so?”. Interrater reliability for coding responses to this question was calculated at .80. When asked if substance use risks and associated consequences were different among ADHD and non-ADHD students, thirty-eight participants (57.6%) reported they were different, followed by those reporting they are the same (18.2%), unsure (13.6%), and depends on the drug (10.6%). When asked how substance use risks and associated consequences among ADHD and non-ADHD students might be different, 22 participants (33.3%) reported there were unsure how they were different or various other responses. This was followed by participants who reported that ADHD students would experience more difficulties with medications/ interactions (13.6%), increased ADHD symptoms (12.1%), self-medication or using substances to cope (12.1%), and increased problems/ addiction (6.1%). Interestingly, five participants (7.6%) stated that using substances (i.e., marijuana) would be helpful for students with ADHD.

Question 4.

Participants were asked "How do you see substance use affecting the academic and psychosocial functioning of ADHD college students?". Interrater reliability for coding responses this question was calculated at .87. Thirty-one participants (47%), reported ADHD college students would experience more academic difficulties, worse ADHD symptoms (22.7%), social problems (15.2%), misuse of ADHD medication (7.6%), and increased stress/ mental health symptoms (4.5%). Thirty-six percent reported other reasons and/or specific difficulties (e.g. depends on the quantity and frequency of substance use, substance use effects might be long-lasting, peer pressure, and laziness). In addition, two participants reported being unsure (3%), while five participants (7.6%) reported there was no difference between ADHD and non-ADHD students in terms of how substances would impact academic and psychosocial functioning. Interestingly, six participants (9.1%) reported that substance use among ADHD students was socially helpful, rather than harmful.

Question 5.

Participants were asked "What do you think might be done to reduce the risk of substance abuse among those with ADHD?". Interrater reliability for coding responses to this question was calculated at .91. Thirty percent of respondents felt there was a need for increased awareness/ education of risks (30.3%), followed by resources/ counseling (15.2%), medical/ prescriber interventions (13.6%), coping skills (10.6%), and social/ alternative activities (10.6%). Twenty-three participants (34.8%), reported other various resources and tools (e.g., more research studies, drug testing/monitoring substance use, and healthier peer relationships). Interestingly, ten participants (15.2%), reported that substance use was a personal choice, and nothing can be done to reduce this risk, while one participant stated that substance use was the same for ADHD and non-ADHD students, indicating there is not an increased risk for ADHD students.

Question 6.

Participants were asked "What could be done generally to better help students with ADHD succeed in college?". Interrater reliability for coding responses to this question was calculated at .74. Approximately twenty percent indicated a need for disability services and accommodations (19.7%), followed by tutoring/ academic services (18.2%), coping skills (15.2%), ADHD specific groups/ support (13.6%), leniency/ less academic demands (13.6%), increased awareness of resources (12.1%), counseling/ therapy services (9.1%), mentor support (9.1%), shorter/ smaller classes (6.1%), and medication (6.1%). Again, there were also a large number (34.8%) of participants who mentioned other possible resources and tools (e.g., frequent reminders for class work, teaching styles that incorporate physical movement, and specific quiet locations to study).

In summary, there were several themes that emerged from the qualitative data analysis. First, participants reported that their ADHD symptoms interfered with studying and academic performance and there is a need for increased coping skills and resources for ADHD students. Second, many of the participants did not report that substance use was different among ADHD and non-ADHD students, while those that believed there was a difference reporting difficulty in understanding why/how this difference occurred. However, many participants did report that individuals with ADHD who also use substances would likely experience many academic difficulties in college. Finally, many participants reported there needs to be increased awareness of the risk of substance use among ADHD students as well as more effective campus services for helping students with ADHD in general.

Chapter V: Discussion

Discussion Overview

The present study sought to evaluate the relationship of general and ADHD specific predictors of substance use to associated problems and functioning in a sample of ADHD college students. Several methods (i.e., parent confirmation of diagnosis and symptoms, self-reported symptoms, SCID-5 semi-structured interview for ADHD) were employed to establish the validity of self-reported ADHD diagnosis in childhood and current symptom status. The study also included assessment of both substance use and negative consequences and the general psychosocial and academic adjustment of ADHD college students at a local university. Moreover, this study sought to add to existing literature by using an objective behavioral measure of ADHD symptom impairment (T.O.V.A.) and in distinguishing between general substance use predictors and ADHD specific risk factors. In addition, it looked at various predictors of substance use within a single model, which expands on previous literature that generally has examined only single relationships. Finally, most importantly, the present study attempted to extend previous research by assessing the possible moderating role of substance use on ADHD's association with psychosocial/academic functioning.

Within this discussion section, I first describe the initial sample findings in more detail and how these findings relate to other samples of college students, specifically, those with ADHD. Next, the primary results of the current study are discussed in general, highlighting consistent and inconsistent findings in relation to other studies. The significant analyses presented in the results section are highlighted rather than repeat those summaries again here. Throughout the discussion section, interpretations of the findings are discussed. Finally, study strengths and limitations are discussed before final conclusions, clinical implications and possible future research directions are presented.

Initial Sample Findings

Participants were a recruited sample of 66 university students who all reported having a history of diagnosed ADHD. Of these individuals, 39 (~59%), reported currently being prescribed medication. Parent report and BARRS-IV Childhood Other Reports were available for over 90% of the sample. All the parents/guardians contacted (100%) confirmed that their child had been diagnosed with ADHD by a professional, albeit some were first identified in early adolescence. By conducting parent reports the study extended prior studies of college ADHD and substance use by utilizing more than just self-report data, which has been heavily criticized in the past (Molina & Pelham, 2014). The sample was therefore considered a valid sample of college students who had received a prior diagnosis of ADHD, albeit varying in symptom status and adjustment.

In terms of comorbid diagnoses, 21 participants reported a history of another mental health diagnosis and three participants reported a history of a learning disorder diagnosis. The most common mental health diagnoses among those who reported a history of a comorbid disorder were anxiety (21.1%) and depression (18.2%). Approximately 88% of these individuals reported currently experiencing associated symptoms/difficulties. This is consistent with prior studies that show similarly high rates of depression and anxiety (APA, 2013) among adults with a diagnosis of ADHD. The present study did not specifically obtain diagnostic information on Conduct Disorder; however, approximately 20% of the sample endorsed four or more symptoms of conduct problems in childhood. Research has shown that approximately 25% of children and adolescents with ADHD have comorbid Conduct Disorder (Willcut et al., 2012), which fortunately often transitions to only ADHD into young adulthood. Moreover, individuals with ADHD who attend college likely have less severe symptoms and fewer overall problems compared to same age peers that are not in college (Blasé et al., 2009). These findings are generally consistent with the present study results.

Current Substance Use and Associated Consequences

In terms of substance use, 89.4% of the present sample reported consuming alcohol at least once in the last 90 days. Moreover, 65.2% reported binge drinking (5+ standard drinks occasion) in the last 90 days. This is slightly higher than other studies of college students with findings indicating rates between 35% and 55% (Skidmore et al., 2016). However, this is understandable considering this sample only included ADHD college students, who are generally more likely to engage in binge drinking than non-ADHD students. Moreover, a pilot study with a large sample of college students from the same university showed similar rates of binge drinking among ADHD students (Mochrie, Whited, Cellucci, Freeman, & Corson, 2018).

Interestingly, there were also a significant number of marijuana users in this sample. Specifically, 56.9% reporting they used marijuana at least once in the last 90 days, with approximately 36% of participants reporting using marijuana at least once a week. This use was similar to that reported in a pilot study among a large sample of university students with 54.8% of ADHD students reporting marijuana use in the past year (Mochrie et al., 2018). This high rate of marijuana use might similarly be explained as due to this being a unique sample of only ADHD students. More specifically, an ADHD sample might be inclined to use marijuana for self-medicating symptoms such as coping with stress, which has been alluded to in previous literature (O'Hara, 2016; Upadhyaya & Carpenter, 2008). An alternate explanation is that societal attitudes towards marijuana use are changing such that there may be more marijuana use among adolescents and college students in general than found in prior years (Hasin et al., 2015). In this sample, there was a relatively low number of other illicit drug users, which is consistent with prior literature with college student populations (Skidmore et al., 2016).

Prior literature has shown that college students experience a variety of negative consequences related to alcohol and other drug use. Specifically, college student substance use has been associated with academic difficulties, negative social-interpersonal consequences, impaired control, and increased engagement in risky behaviors (Read et al., 2006). Moreover, ADHD college students are at a higher risk of experiencing these consequences compared to non-ADHD peers (Skidmore et al., 2016; Weyandt & DuPaul, 2008). When examining substance use consequences in the present sample, on average, participants reported approximately eight alcohol-related consequences and five drug-related consequences in the last three months. The most commonly reported alcohol-related consequences in the last three months were neglecting responsibilities, having a bad time, missing classes, and trying to control drinking without success. In addition, the most commonly reported drug-related consequences in the last three months were being unhappy due to drug use, taking risks while under the influence of drugs, failing to meet expectations, and spending too much money due to drug use. These consequences are similar to those found in other studies of college students and confirm that ADHD college students experience a variety of negative consequences from alcohol and other drug use (Dattilo et al., 2013). In addition, qualitative data collected from the present sample supports these reported negative consequences, especially in terms of neglecting responsibilities, difficulty making it to class, and impulsive behavior.

Moreover, as hypothesized, quantity and frequency of current substance use in the last 90 days was related to substance-related negative consequences. Specifically, quantity and frequency of current alcohol use was positively correlated with the RAPI, indicating that participants' who reported more current alcohol use also reported more alcohol-related negative consequences in the last three months. Moreover, those who reported more current marijuana use and other illicit drug use also reported more drug-related problems on the SIP-D. In addition, prescription stimulant abuse was associated with alcohol and other drug use as well as substance use negative consequences in this sample. This is consistent with prior studies indicating these relationships between stimulant misuse and alcohol/other drug use and associated consequences (Benson et al., 2015). These findings are also consistent with prior studies of college student substance use which indicate a dose relationship such that higher quantity and frequency of substance use relates to increased substance-related negative consequences (Skidmore et al., 2016; Slutske, 2005).

Current ADHD Symptoms and Functioning

In terms of current ADHD symptoms, 95.5% of the participants were classified by the ASRS as highly likely to currently have ADHD, with the majority of participants having inattentive type compared to hyperactive/impulsive type. This is consistent with other studies which suggest that inattentive symptoms are more frequent and that as younger children with ADHD enter into young adulthood, they tend to experience more symptoms of inattention compared to hyperactive/impulsive symptoms (Sibley et al., 2012). Moreover, on the BARRS-IV Childhood self-report measure, 60.6% of the sample met symptom count criteria for having a diagnosis of ADHD in childhood. The majority of these participants endorsed meeting symptom count criteria for ADHD combined presentation in childhood (n = 21). The majority of the sample (81.8%) also met criteria for currently having ADHD on the SCID-5. Although a number of participants did not meet criteria for ADHD on the SCID-5, this is to be expected due to many individuals experiencing more symptoms of ADHD as children and less as adults, most likely from both maturation and acquiring increased coping skills (Cheung et al., 2015). Finally, it should not necessarily be interpreted that those who did not appear to meet criteria on the SCID-5 never met criteria for a diagnosis of ADHD; although they could have had subclinical symptoms; this most likely reflects a lessoning of their symptoms over time. Further, data collected on the ASRS indicated a clear symptom distribution which allowed for examining the severity of ADHD symptoms on current functioning within this sample.

Psychosocial and Academic Functioning of the Sample

Many studies have found that ADHD college students are at an increased risk for both psychosocial and academic difficulties compared to non-ADHD peers (Weyandt & DuPaul, 2013; Yang et al., 2013). The present study sought to replicate these findings by assessing psychosocial adjustment, measured in terms of depression (PHQ-9 total scores), anxiety (GAD-7 total scores), and social adjustment to college (SACQ – Social Adjustment Subscale, total scores). The current sample contained 34 individuals

(51.5%) who met the suggested clinical cut-off score ($\geq$ 8) for depression on the PHQ-9. The PHQ-9 total score ranged from 1 to 25 (*M* = 9.58, SD = 6.44) out of a possible 27 total points, with higher scores indicating more current symptoms of depression. In terms of anxiety, 22 (33.3%) of participants met the suggested clinical cut-off score ($\geq$ 10) on the GAD-7 for current anxiety symptoms. Further, total scores on this measure ranged from 0 to 21 (*M* = 8.06, SD = 6.39) out of a possible 21, with higher scores indicating more current symptoms of anxiety. On the SACQ – Social Adjustment Subscale, participant's scores ranged from 12 to 73 (*M* = 46.71, SD = 13.86) out of a possible 120, with higher scores indicating better academic adjustment to college. These numbers are similar to those found in a pilot study comparing ADHD and non-ADHD college students conducted with the same university sample (Mochrie et al., 2018). The high number of individuals reporting depression in the present sample likely reflects the association of depression with the diagnosis of ADHD. Prior literature has demonstrated a high comorbidity between ADHD and depression as well as anxiety (APA, 2013).

In terms of academic functioning, the present sample measured academic adjustment to college by self-reported current GPA and an academic adjustment scale (SACQ – Academic Adjustment Subscale). Findings showed GPA scores ranging considerably from .18 to 4.0 (*M* = 2.76, SD = .83). On the SACQ – Academic Adjustment Subscale, participant's scores ranged from 22 to 81 (*M* = 50.68, SD = 11.62) out of a possible 120, with higher scores indicating better academic adjustment to college. Overall, these findings indicate there was a significant number of ADHD students in the present sample whose academic functioning was of concern.

Unfortunately, many studies suggest college students with ADHD are at a higher risk for academic problems than those without this diagnosis (Weyandt et al., 2013; Wolf, 2001).

The present study findings confirm that recruitment of a college sample previously diagnosed with ADHD identifies many individuals at risk for significant psychosocial and academic adjustment difficulties, although some of these at-risk students are functioning better than others, raising the question of what predicts adjustment in this population.

Major Study Findings: Understanding Substance Use Among ADHD Students

Relationship of General Risk Factors to Substance Use and Consequences. There is a large literature base that describes the relationship of various risk factors to substance use among college students. The present study attempted to replicate these findings within a sample of all ADHD college students by assessing the relationship of these general risk predictors to current substance use and associated consequences.

Prior literature has demonstrated that individuals who have a history of substance use in adolescence are at a higher risk for increased use during college (Merline et al., 2004; Wechsler et al., 1995). In the present study sample, as hypothesized, younger age of alcohol use predicted more current alcohol consumption and classification as a binge drinker. Prior research suggests that individuals who use alcohol at earlier ages often consume more as they enter emerging adulthood (Borsari et al., 2007), which is consistent with this finding. However, contrary to prior studies that have shown a similar link between alcohol use history and current consequences from use in college (Lakhan, & Kirchgessner, 2012), the present study did not find this relationship. It is possible, that this sample did not include many past heavy alcohol users and therefore findings did not support this relationship. Further, it may be that ADHD students do not perceive that their alcohol use is causing major problems in functioning and instead believe it is ADHD symptoms. Reporting alcohol use history is less subjective than reporting severity of problems associated with current alcohol use which might partially account for this finding.

In terms of other drug use, as hypothesized, younger age of first marijuana use predicted more current use and classification as a regular marijuana user. Further, having a history of illicit drug use predicted more drug-related consequences on the SIP-D. These findings are consistent with prior studies which suggest strong relationships between past marijuana use and current use/negative consequences (Ferdinand et al., 2005). Interestingly, having a history of illicit substance use did not predict current illicit use or misuse of ADHD stimulant medication. In the present study sample, there were very few current other illicit drug users (N = 13) and only 16 participants reported ADHD stimulant medication misuse in the past year, helping to explain the lack of relationship between past use and current misuse of these substances. Given that abuse of alcohol and other drugs was related to stimulant misuse in this sample, it is likely a relationship with history would be found with a larger sample size and more statistical power.

In addition to substance use history, there is a plethora of research showing a relationship between having a history of conduct disorder/problems and increased substance use and associated consequences among college students (Falls et al., 2011). In general, reported history of conduct problems was a good predictor of substance use patterns and associated negative consequences in this sample. Specifically, as hypothesized, more reported conduct problems in childhood predicted more current alcohol consumption, classification as a binge drinker, and more alcohol-related negative consequences. Moreover, more reported conduct problems in childhood predicted more current marijuana use and classification as a regular marijuana user, and more drug-related consequences.

In the present study sample, individuals with a greater history of conduct problems experienced more substance abuse issues as college students. This is likely due to the relationship between childhood ADHD, a greater history of conduct problems in childhood, and current higher severity of ADHD symptoms. Prior research supports these findings (Willcut et al., 2012), in that ADHD and conduct problems in childhood often manifest as only continued ADHD symptoms in adulthood.

Similar to substance use history, history of conduct problems did not predict other current illicit drug use or misuse of ADHD stimulant medication most likely due to a low number of individuals who used these substances. Clearly, a history of childhood conduct problems accompanying ADHD symptoms influences substance use risk among college students with ADHD. It is likely some of the impulsive behavior that occurs with a history of conduct problems carries over into early adulthood and accounts for increased use in this population. These findings also provide evidence supporting using conduct problems as a covariate due to an overlap between these difficulties and ADHD symptoms, which both relate to increased substance use and associated consequences (Glass & Flory, 2011; Rooney et al., 2012).

Another commonly found general risk factor for substance use among college students is peer influence or perceived norms regarding peer use (Skidmore et al., 2016). In the present sample, peer influence only predicted current alcohol consumption and classification as a binge drinker. Specifically, higher perceptions of peer use predicted more current alcohol consumption and being classified as a binge drinker. This is consistent with the Van Eck et al. (2014) study showing that among ADHD students peer influence plays a significant role in alcohol consumption among college students. Surprisingly, perceived peer use did not predict alcohol-related negative consequences in this sample or use of marijuana or other drugs or associated consequences. Again, it is possible this relationship was not found due to the low number of individuals who reported using other drugs in the sample. Of note, the peer influence measure used in this study was modified from a larger, more commonly used measure originally from the originally from the Monitoring the Future study (Johnston, O'Malley, & Bachman, 1988). This adapted measure only contained three items that specifically assessed perceptions of peer marijuana use. It is possible, that with a different measure containing more items assessing perceptions of peer marijuana use, some of these findings would be significant. Moreover, peers would be expected to influence consequences indirectly at best. It makes sense that perceived norms might influence alcohol use as this has been commonly found in prior literature (Skidmore et al., 2016); however, there are fewer studies showing that peer norms influence alcohol-related consequences, especially among ADHD college students. It is likely that peer influence is not directly related to alcohol-related consequences and is a better predictor of quantity and frequency of alcohol use.

There are also a variety of studies that demonstrate the relationship between increased positive substance use expectancies and increased substance use and associated negative consequences among college students (Brackenbury & Anderson, 2016; Gilles, Turk, & Fresco, 2006; Neighbors et al., 2008). In the present study sample, positive alcohol and marijuana expectancies were both excellent predictors of substance use patterns and associated negative consequences. Specifically, higher positive alcohol expectancies predicted more current alcohol use, classification as a binge drinker, and more alcohol-related negative consequences, which replicate prior findings. College students who associate drinking with more positive physical and social results engage in heavier and more frequent drinking than those that do not, helping to explain these findings. It is likely that this increased alcohol use leads to more alcohol-related consequences as has been found in prior studies (Knee & Neighbors, 2002; Wechsler et al., 2002).

In addition, higher marijuana expectancies predicted more current marijuana use, classification a regular marijuana user, more drug-related problems, current illicit drug use, and even current misuse of ADHD stimulant medication. It is likely that participants' who have positive perceptions of marijuana are at an increased risk for greater use as well as having higher positive perceptions about other drugs, which may account for these findings. Moreover, as with alcohol use, those engaging in more frequent and heavier marijuana use are also experiencing more drug-related consequences, which has previously been found in the literature (Wahesh et al., 2015).

Finally, studies have demonstrated a relationship between sensation seeking traits and increased substance use and associated consequences among college students (Cyders et al., 2009; Kazemi et al., 2014). However, the present findings in regard to sensation seeking as a general predictor of current substance use patterns and associated negative consequences were poor. Overall, the sensation seeking measure used was shown to be unreliable and was not a good predictor of the majority of the criterion variables. In the few cases where there was a significant prediction it was related in the opposite direction than hypothesized (i.e., binge drinking, alcohol consequences, drug use consequences). Importantly, these findings are completely inconsistent from those of prior studies using the same measure with college students. There are several reasons why this may be the case. First, no studies have used this sensation seeking measure with only ADHD college students. Second, due to the poor reliability of this measure (Cronbach's Alpha = .15), it cannot be determined whether or not this measure was actually assessing the construct of sensation seeking in this sample. It may be the case that this measure of sensation seeking would have a higher internal consistency as well as more predictive value if a non-ADHD comparison sample was included. Finally, when examining the range of scores there was very little variance, with the vast majority of scores falling in the middle range (5 – 8 raw scores) for sensation seeking traits, which decreases the likelihood of finding significant relationships.

Overall, general substance predictors in this ADHD sample were found to have good predictive value in that they were associated with substance use patterns and associated negative consequences. These findings were generally consistent with the literature on college student substance use (Skidmore, 2016). Specifically, substance use history predicted all the substance criterion variables except for current other illicit use and misuse of ADHD stimulant medication. Similarly, history of conduct problems predicted all the substance criterion variables except for current other illicit use and misuse of ADHD stimulant medication. However, the latter was associated with current abuse of alcohol and other drugs as has been reported by others (Messina et al., 2014). The results of peer influence as a general substance predictor were less consistent, in that it only predicted current alcohol consumption and classification as a binge drinker. Moreover, positive alcohol and marijuana expectancies emerged as excellent predictors, in that they predicted all the substance criterion variables in the expected direction. It would seem that positive expectancies for marijuana generally held across all substance use in the sample. Surprisingly, sensation seeking as a general predictor was poor in this sample, most likely due to reliability issues previously mentioned.

In conclusion, these results add to the small existing literature base on ADHD and substance use by replicating previous findings of general predictors of substance use/consequences risk within an all ADHD college student sample. That these same variables are predictive among ADHD students is important in both understanding their increased risk as well as designing interventions. These results provide further evidence for assessing these constructs among college ADHD students to help identify substance abuse risk and inform prevention and treatment strategies which are discussed in more detail later.

Relationship of ADHD Specific Factors to Substance Use and Consequences. As reviewed in the introduction to this project, prior research has established an increased risk of substance abuse associated with ADHD diagnosis using mostly between subject designs (Mochrie et al., 2018; Upadhyaya & Carpenter, 2008). Only a few studies have assessed the relationship of what might be considered

ADHD specific factors to substance use and associated consequences among college students. One area of interest has been the relationship of ADHD symptoms to substance use and consequences among this population. In their sample, Upadhyaya and Carpenter (2008) found that the total number of ADHD symptoms was significantly associated with the frequency of alcohol, tobacco, and marijuana use in the past month. Moreover, another study found that symptoms of inattention were related to alcohol problems among college students, while hyperactivity symptoms were less related to substance use and consequences (Mesman, 2015). The present study sought to examine the relationship between current ADHD symptoms and current substance use and associated consequences in an all ADHD sample. Self-report (ASRS) and objective behavioral assessment (T.O.V.A.) were used to examine severity of symptoms and impairment due to ADHD. Due to prior literature showing possible differences in the type of symptoms (inattention versus hyperactive) these were examined separately on the ASRS; however, in the present sample there were no differences in correlations across symptom types. Therefore, symptoms were combined to look at total severity of symptoms on the ASRS.

Surprisingly, severity of ADHD symptoms on the ASRS was a poor predictor of substance use patterns and associated negative consequences in this sample. There were no substance use or consequence criterion variables that were significantly associated with ASRS symptoms. Although the ASRS significantly predicted drug-use negative consequences on the SIP-D, this was no longer significant after controlling variables were added. Specifically, report of childhood conduct disorder problems accounted for most of the variance in the regression model. These findings are somewhat unique in that they contradict some previous literature and assumptions. In prior research that incorporated non-ADHD subjects, symptom severity would essentially be a proxy for diagnosis. It is also understandable that having a history of conduct problems might better account for differences in substance use and consequences rather than severity of ADHD symptoms as the former might be considered a possible mediator. In addition, this finding may reflect a developmental course of vulnerability to elevated substance use in early adulthood. Specifically, prior research has found that worsening inattention symptoms and delinquency during adolescence are associated with higher levels of early adult substance use (Howard et al., 2015). It may be that the conduct disorder symptoms (delinquency) carry most of the variance in substance use as in the present study findings. Moreover, a college sample of individuals with ADHD is likely to have more coping skills and control over symptoms compared to same age peers who are not attending college, which has been demonstrated in prior research (Weyandt & DuPaul, 2008). Perhaps this reflects an overall lessoning of symptoms upon entering college which accounts for the lack of finding between severity of symptoms and substance use and associated consequences in the current study.

In terms of objective behavioral assessment of impairment due to attention symptoms, various analyses in which T.O.V.A scores were used to predict substance use or substance use consequences similarly resulted in minimal findings within this sample. The T.O.V.A. findings were described above for RTV, RT, CE, and OE. There were no significant findings for RTV or OE in this sample. It may be the case, as was with the ASRS, that general predictors (i.e., history of conduct problems) better account for differences in substance use and associated consequences. In addition, while there are studies that have utilized the T.O.V.A. in substance abuse samples, there is a lack of research on using the T.O.V.A. to predict substance use and consequences, making the present study somewhat exploratory in nature.

Interestingly, participants with more commission errors (CE; impulsivity) on the T.O.V.A. were more likely to be current other illicit drug users. It is likely that individuals who use more illicit substances also struggle with impulsivity, which is indicated by this finding. As with any correlation, it might also be that drug use elicits greater impulsivity (De Witt, 2009). In one T.O.V.A. analysis, the findings were in the opposite direction as hypothesized. Specifically, participants with faster overall response times (RT) were more likely to be current other illicit drug users. It is possible that these individuals responding more quickly to stimuli reflected some aspect of substance use such as excitement seeking or impulsivity, but any interpretation is necessarily speculative.

Generally, in this sample of all ADHD college students, the T.O.V.A. variables were not found to be very predictive of substance use patterns and negative consequences. This provides further evidence that severity of ADHD symptom impairment may not be a direct predictor of substance use and associated consequences among ADHD college students. The best predictors of substance use that emerged in the present study were general substance abuse predictors (i.e., substance use history, conduct problems, positive expectancies, and perceptions of peer use) and it may be that the ADHD risk for substance abuse is best understood as operating through these general substance use predictors.

Numerous studies have examined the role of impulsivity on college student substance use. Previous findings suggest that impulsivity is related to alcohol use and associated consequences among young adults (Kiselica et al., 2015). There is also a clear link between ADHD and higher impulsivity (Barnhart & Buelow, 2017), providing a strong rationale for assessing this as an ADHD specific predictor of substance use and associated consequences.

However, there are many different methods and assessment instruments that can be used to measure impulsivity among substance abuse populations; one such method is the delayed discounting paradigm which has shown a link between impulsivity and substance use/consequences (Kollins, 2013). In addition, other measures of impulsivity have been used in ADHD populations. For example, Barnhart and Buelow (2017), found attentional impulsivity on the BIS (Behavioral Inhibition) was able to distinguish between college students with and without a self-reported diagnosis of ADHD, with those having reported ADHD experiencing higher levels of impulsivity. There are also studies that have demonstrated the utility of using the UPPS-P to examine impulsivity in relationship to substance use and consequences (Blanchard et al., 2017). While there are many studies that have used the UPPS-P to assess substance abuse (McCarty, 2017), very few studies have used this tool among ADHD individuals. The one study reported earlier (Lopez et al., 2015), found that adults with ADHD had higher urgency, lower premeditation, and lower perseverance scores on the UPPS-P compared to a control group.

The present study used a shortened version of the UPPS-P to examine substance use/consequences in a college sample of all ADHD students, and therefore it might be considered exploratory. Contrary to the hypotheses, various analyses in which higher positive urgency or impulsivity was used to predict substance use or substance use consequences resulted in minimal findings. In fact, there was only one case where the results were significant. Specifically, participants who reported higher levels of impulsivity, reported more drug use consequences on the SIP-D. This lack of findings is surprising given the links between ADHD, impulsivity, and substance use/ consequences. However, when examining the range of scores for impulsivity on the SUPPS-P, the majority of participants had low overall scores. It is likely that significant relationships may have been found if there was a wider range in these scores. In this sample there was no significant relationship between the SUPPS-P Positive Urgency subscale and hyperactive/impulsive symptoms on the ASRS. Conceptually, these two measures should probably be related; perhaps this lack of relationship reflects a poor understanding of general impulsivity symptoms versus those related to ADHD. It may be the case that if this sample were compared non-ADHD participants this relationship with impulsivity would be significant. In addition, the one finding of the positive relationship between those reporting more impulsivity and drug-use consequences makes sense given that these individuals are likely polysubstance users and are therefore more likely to experience greater substance-related consequences in general.

In addition, to positive urgency (impulsivity), negative urgency (emotion dysregulation), was assessed. Previous studies have examined negative urgency on the UPPS-P in relation to substance use among adults (Pedersen, Walther, Harty, Gnagy, Pelham, & Molina, 2016; McCarty et al., 2017). However, these particular analyses, like those with positive urgency, were somewhat exploratory in nature due to a dearth of previous studies using this tool in relation to substance use and associated consequences among a sample of all ADHD college students. Moreover, no studies have used the shortened version of this measure to assess the present study hypotheses. Various analyses in which negative urgency or emotion dysregulation scores were used to predict substance use or substance use consequences also resulted in minimal findings within this sample. In fact, there was only one case where the results were significant. Specifically, participants who reported higher negative urgency, reported more alcohol-related negative consequences on the RAPI. These findings mirror those found with positive urgency or impulsivity on the SUPPS-P. It is likely that some of these relationships would be significant if the study included non-ADHD participants due to the relationship of emotion dysregulation and substance use among general college students. However, conceptually, it makes sense that emotion dysregulation would be associated with alcohol-related negative consequences given that many of these consequences are emotional in nature. In this sample of all ADHD college students, negative urgency (emotion dysregulation) was not a good predictor of substance use patterns; however, it proved useful in predicting alcohol-related negative consequences.

Lastly, executive functioning deficits are strongly associated with having ADHD (Barkley & Murphy, 2011; Weyandt, Oster, Gudmundsdottir, DuPaul, & Anastopoulos, 2017) and were considered an ADHD specific predictor in this study. Various analyses in which reported deficits in executive functioning (BDEFS-CA total raw scores) were used to predict substance use or substance use consequences were also largely negative. In fact, there was only one case where the results were significant. Specifically, participants who reported more executive functioning deficits, reported more drug-related negative consequences on the SIP-D. When examining these data further there was good variability between scores, indicating that the lack of findings was not due to issues with variance. Of note, the BDEFS-CA was used rather than the original BDEFS for adults. Although, these measures are very similar and thought to measure the same constructs, it is possible that there would be more significant relationships if the adult version were used. In addition, it may be that some of these relationships would have been significant if the sample included non-ADHD participants. Some research has pointed to a general dimension of inhibition (executive control) as a mechanism for behavioral disinhibition throughout adolescence which is commonly associated with ADHD (Young, Friedman, Miyake, Willcutt, Corley, Haberstick, & Hewitt, 2009). Given this established relationship, it is possible that specifically measuring response inhibition would have resulted in more significant findings between executive functioning deficits and substance use in the present study.

Of note, it is also possible there is a lack of findings due to how one defines heavy drinking. For example, in the present study there were only 13 participants who engaged in heavier drinking (defined as more than 14 standard drinks per week in last 3 months). Perhaps this relationship would be significant in a larger sample with more drinking. Despite the lack of findings, executive functioning deficits did relate to more-drug related problems, which likely reflects an overlap between consequences related to school (e.g., missing class) and executive functioning difficulties (e.g., organization issues).

Overall, in contrast to the general substance abuse predictors, the ADHD specific predictors had surprisingly limited value in predicting substance use patterns and associated negative consequences in this ADHD sample. In fact, severity of symptoms on the ASRS predicted none of the substance criterion variables. There were limited T.O.V.A. findings; T.O.V.A. RT predicted Other illicit drug use, such that those with faster RT reported using Other illicit drugs in the last 90 days. As hypothesized, T.O.V.A. CE also predicted Other illicit drug use, such that those with more commission errors were also using illicit drugs. In terms of positive urgency or impulsivity, as hypothesized, those reporting higher levels of impulsivity, reported more drug-related consequences on the SIP-D. However, positive urgency (impulsivity) did not predict any other substance criterion variables. Moreover, as hypothesized, those reporting higher emotion dysregulation, reported more alcohol-related consequences on the RAPI. However, negative urgency (emotion dysregulation) also did not predict any other substance criterion variables. Finally, executive functioning deficits only successfully predicted drug-related consequences on the SIP-D, such that those reporting more executive functioning deficits, reported more drug-related consequences. It seems that these various ADHD specific factors were more strongly related to experiencing negative consequences rather than use per se. These findings partially supported the study hypotheses. Mirroring prior research, conduct disorder problems were included as a covariate. It is likely that more significant relationships between ADHD specific factors and substance use/consequences would have been found if conduct problems were not controlled for during analyses. Overall however, ADHD specific factors did not seem to increase variance in substance use consequences explained by general predictors. Perhaps the risk conferred by ADHD operates over time though general predictors (e.g., including conduct problems, expectancies) rather than specific ones, although certainly ADHD factors may heighten risk of negative consequences.

Best Predictions of Substance Use and Consequences. There is some preliminary literature that has examined substance use and associated consequences among ADHD college students; however, this is still a relatively new area of research. There are several themes within the existing literature on college students that have been found. First, there is a relationship between ADHD diagnosis and substance use (Blasé et al., 2009; Dattilo et al., 2013). Second, current ADHD symptoms have sometimes been associated with increased use of substances, with an emphasis on symptoms of inattention versus hyperactive/impulsive symptoms (Baker et al., 2012; Murphy et al., 2002). However, the majority of research points to symptoms of ADHD being related to substance use other than alcohol (e.g., tobacco, marijuana, etc.) (Upadhyaya & Carpenter, 2008). ADHD diagnosis and symptoms also predict substance use associated consequences among emerging adults and college students (Mesman, 2015; Rooney et al., 2015). Further, ADHD has been associated with deficits in executive functioning among this population (Tamm et al., 2013), that likely interfere with a student's ability to function at a high level academically. In addition, the literature shows a link between ADHD and higher levels of psychological distress among college students with ADHD as well as concurrent substance use when examined separately (Mochrie et al., 2018). Next, a history of conduct disorder problems, and/or antisocial personality traits is also associated with an increased risk for substance use and associated consequences among emerging adults including college students (Bergman, et al., 2016; Rooney et al., 2012; Wilens et al., 2011). Finally, college students with

ADHD who enter college are at a greater risk for using substances, in particular alcohol and marijuana (Hartung et al., 2013; Mesman, 2015; Rooney et al., 2012).

The majority of these studies have looked at single predictors of substance use, rather than multiple predictors within a single model. Moreover, many of these studies examined differences between ADHD and non-ADHD college students. The present study added to this existing literature base by attempting to evaluate the best models for predicting current use of various substances and associated consequences among an all ADHD college student sample.

As described above, various multiple linear and logistic regression analyses were used to determine the best predictors of substance use patterns and associated negative consequences in this sample. Overall, having a history of substance use and positive substance use expectancies emerged as important predictors for many of the substance criterion variables. Further, ADHD specific factors only minimally impacted the results, with most substance criterion variables being predicted by general substance use predictors. It seems that general predictors of substance use risk among ADHD college students can be used in most cases to best predict this risk. The specifics of these best model results for various substances with their possible meaning and implications are discussed below.

In terms of alcohol use, age of first alcohol use was the best significant predictor of both current alcohol consumption and binge drinker status in this sample. Specifically, participants that reported using alcohol at younger ages also reported more current alcohol consumption and were classified as binge drinkers. The regression models accounted for approximately 40% and 43% of the variance in current alcohol use and binge drinking status, respectively. This is consistent with prior studies identifying history of alcohol use as an important predictor of current use and consequences (Hingson, 2006).

In addition, higher alcohol expectancies predicted more alcohol-related negative consequences on the RAPI; however, no other predictors were significant even before controlling for demographics and removing the variance due to expectancies. This regression model accounted for approximately 58% of the variance in RAPI scores. Positive alcohol expectancies are known to be associated with increased alcohol consumption (Neigbors, 2008), and were the best predictor for alcohol-related consequences among these ADHD college students. It seems that ADHD students, similar to college students in general who have positive alcohol expectancies also engage in heavier drinking and experience more alcohol-related negative consequences than those with less overall positive expectancies.

Similarly, higher positive marijuana expectancies best predicted more current marijuana use and classification as a regular marijuana user. The regression models accounted for approximately 51% and 43% of the variance in current marijuana use and classification as a regular marijuana user, respectively. These findings mimic those of alcohol expectancies in this sample. It is likely that many college students with ADHD are unaware of (or do not believe) the negative effects that marijuana can have on their functioning. In fact, there were several participants in the study who stated that marijuana helps reduce their symptoms of ADHD when being asked the qualitative questions. While it is possible marijuana helps some individuals regulate affect, this speaks to the lack of knowledge/understanding of ADHD college students may have about both their ADHD (Anastopoulos, & King, 2015) and effects of drugs.

Regarding Other illicit drug use, having a history of illicit drug use and higher T.O.V.A. CE (impulsivity) best predicted Other drug use, accounting for 16% of the variance. This is only a modest prediction; however, there were very few current Other illicit drug users in the sample, which might account for the low amount of variance explained. Despite the modest nature of this finding, it is still significant, and should be considered important. Specifically, a combination of drug use history and impulsivity symptoms were the best predictors for illicit drug use in the sample, indicating that special attention should be given to these risks. This unique group of students are likely using more substances and experiencing more overall consequences than others. Moreover, it is possible that some students seeking help for ADHD difficulties are actually experiencing a combination of ADHD symptoms and substance use problems.

Finally, although included as a study variable it was difficult in this sample to predict misuse of ADHD stimulant medication from the general substance use predictors. Specifically, only positive marijuana expectancies were a significant predictor of misuse of ADHD stimulant medication; however, this only accounted for 4.0% of the variance. Mirroring earlier work (Mochrie et al., 2018), participants were asked about misuse of stimulants over the last year and it is not clear how frequently this occurred among participants who acknowledged misuse. In prior general college student surveys of stimulant misuse (Messina et al., 2014), and within the current sample, stimulant misuse was associated with abuse of alcohol and other drugs. It is likely that individuals who have positive marijuana expectancies also have positive overall drug expectancies explaining possible misuse of medication as well.

Interestingly, positive urgency (impulsivity) did emerge as a significant ADHD specific predictor of drug-related consequences in a multiple linear regression model. Specifically, history of illicit drug use, higher positive marijuana expectancies, and higher positive urgency emerged as significant predictors of more drug-related consequences on the SIP-D, which accounted for approximately 50% of the variance in SIP-D scores. It seems that within this sample of ADHD college students, those who had a history of illicit drug use and currently have positive expectations for marijuana use combined with higher impulsivity are more likely to experience drug-related negative consequences. This finding is important for two distinct reasons. First, it confirms that impulsivity symptoms should be not only assessed but also addressed as a risk factor when working with ADHD college students (Pederson et al, 2016). Second, it reiterates other findings that substance use history is extremely important for identifying increased risk for further experiencing substance use negative consequences.

Interaction of ADHD Symptoms and Substance Use

Prior research points to ADHD diagnosis and symptoms and their link to increased substance use (Mesman, 2015; Molina & Pelham, 2014). Specifically, some research has found that having a higher number of total ADHD symptoms is associated with current frequency of alcohol, tobacco, and marijuana use among college students (Upadhyaya & Carpenter, 2008). Other research has shown differences between inattention and hyperactive symptoms in relation to substance use among college students (Mesman, 2015). However, the present study did not find any differences in symptom type and therefore used the total number of ADHD symptoms. It is possible that this relationship was not found due to a lack of statistical power and perhaps with a larger sample size this could be assessed better.

There is also a known clear link between substance use and associated negative consequences among college students, with those who engage in higher use also reporting more consequences (Bell et al., 1997; Read et al., 2006). Taken together, these findings suggest that both ADHD symptoms and current substance use are associated with substance-related negative consequences. This begs the question; is there an interaction effect between ADHD symptoms and substance use (i.e. combined or comorbid effect) on substance-related negative consequences? The current study went beyond prior research in attempting to answer this question.

Several moderation analyses described above in the results section were conducted to examine if attentional symptoms (ASRS) interacted with substance use to influence substance use negative consequences. Some evidence for this interaction was found for the ASRS and marijuana use in which higher severity of symptoms on the ASRS when interacting with current marijuana use, predicted more drug use consequences on the SIP-D at high levels of marijuana use. Moreover, this was also true when examining classification as a regular marijuana user. It is likely that heavy marijuana use exacerbates symptoms of ADHD helping to explain this finding. For example, students who have difficulty with attention, concentration, and focus due to ADHD symptoms may already experience problems with academic performance and functioning. If these individuals are also using marijuana in higher frequency/quantity than others the effects of marijuana (e.g., attention/concentration issues, memory difficulty, etc.) may only make it more likely these college students with ADHD will struggle with associated negative consequences.

Interestingly, there were no significant interaction findings for alcohol use, suggesting that in this sample, greater ADHD symptom severity interacted more with marijuana use in accounting for more substance-related negative consequences. It is possible that these participants experienced similar alcohol-related consequences regardless of the severity of their ADHD symptoms. Prior studies show that even college students without ADHD experience many alcohol-related consequences (Skidmore et al., 2016), providing some evidence for this interpretation.

Major Study Findings: ADHD Factors in Relation to Psychosocial and Academic Functioning

ADHD Symptoms in Relation to Psychosocial and Academic Functioning. ADHD college students are at a greater risk for psychosocial functioning problems compared to non-ADHD students. Specifically, research has demonstrated a link between college students with ADHD and depression symptoms (Blasé et al., 2009; Mochrie et al., 2018). Moreover, Yang et al. (2013) found that current ADHD symptoms predicted greater negative impact on life functioning (i.e., productivity; psychological health; relationships; life outlook), specifically, showing decreased overall quality of life among young adults. Still, there is limited research directly examining the link between ADHD symptom severity and psychosocial functioning among college students with a diagnosis of ADHD. Several studies found that in young adults with ADHD, their self-report symptoms were associated with problems in various areas including and social functioning, sleep, and aggression (DuPaul et al., 2018; Travell, & Visser, 2006); however, more information is needed about this topic.

In addition to psychosocial functioning difficulties, many college students with ADHD experience academic problems. Research has demonstrated that ADHD students generally have lower overall GPA's, poor performance on class assignments, higher rates of academic probation, higher rates of dropping classes, and lower rates of graduation (Frazier et al., 2007; Turnock, Rosen, & Kaminski, 1998; Weyandt & DuPaul, 2013; Wolf, 2001). However, there is less research that has examined the specific ADHD difficulties (e.g., symptoms) that may actually impact academic functioning. Interestingly, Kessler et al. (2006) found that among adults with ADHD, severity of symptoms was related to limited educational or job attainment, attendance problems, poor occupational performance, and higher probability of unemployment. Moreover, one study found that symptoms of inattention predicted poorer academic status and greater likelihood of academic probation among college students (Frazier, Youngstrom, Glutting, & Watkins, 2007). However, as is the case with psychosocial functioning, there are fewer specific studies of college students with ADHD and how specific factors may relate to these academic problems. The present study addressed these issues in exploring the relationship of specific ADHD factors (e.g., severity of symptoms) to psychosocial and academic functioning.

First, the study findings revealed that severity of ADHD symptoms on the ASRS significantly predicted both psychosocial and academic functioning in this sample. Specifically, higher severity of symptoms on the ASRS predicted more current symptoms of depression and anxiety on the PHQ-9 and GAD-7, respectively.

Interestingly, these findings expand upon prior studies using ADHD diagnosis as a predictor of depression/anxiety (Yang et al., 2013), to show that ADHD college students with a higher degree of severity of symptoms are at a greater risk for depression and anxiety than ADHD students with less symptoms. This finding also supports the difficulties and themes participants expressed on the qualitative questions such as poor academic functioning and difficulties with social and emotional functioning, which are also consistent with prior studies of qualitative data (Kwon, Kim, & Kwak, 2018).

Moreover, more academic adjustment difficulties on the SACQ were predicted by higher scores on the ASRS. This suggests a direct link between ADHD symptom severity and academic problems (e.g., organization of schedule, adjustment to coursework, etc.) among this sample. Findings indicate that college students with a diagnosis of ADHD and more current symptoms likely experience more academic distress than those with less symptoms. However, contrary to hypotheses, in the present study the ASRS was not significant in predicting current GPA or social adjustment, after controlling for age, sex, and current year in college. Other studies have found that ADHD diagnosis itself does not necessarily predict GPA among college students (Mochrie et al., 2018), providing some consistency for this finding. Certainly, there are many factors that influence GPA which is farther removed from day to day functioning then reported academic difficulties on SACQ. In addition, it seems that severity of symptoms is a better predictor of depression and anxiety symptoms rather than social adjustment in this sample. Of note, it is also understandable that other variables such as younger age and lower current year in college better accounted for reported differences in social adjustment.

In addition, the T.O.V.A. was used as a measure of ADHD symptom impairment in the present study. Various analyses in which T.O.V.A scores were used to predict psychosocial and academic functioning resulted in minimal findings within this sample. In fact, none of the T.O.V.A. variables were successful at predicting psychosocial and academic problems, even when using dichotomized variables to determine if the T.O.V.A. variable scores were outside normal limits.

The literature relating T.O.V.A. performance to ADHD status and symptoms appears somewhat mixed. Many studies clearly support the use of the T.O.V.A. to help differentiate individuals with and without ADHD (Forbes, 1998). These studies have been conducted using a between-subjects design, comparing ADHD and non-ADHD individuals. However, other studies do not always support the use of this measure to distinguish between ADHD and non-ADHD individuals. For example, Preston, Fennell, and Bussing (2005) found no significant differences between ADHD and subclinical children on the T.O.V.A. variables, and T.O.V.A. performance did not reliably predict group membership. Interestingly, other prior research with children has concluded that the T.O.V.A. should not be the only tool to use for ADHD diagnostic purposes due to its low specificity (Zelnik, Bennett-Back, Miari, Goez, & Fattal-Valevski, 2012). Moreover, the T.O.V.A. company recommends that all examinations be conducted in the morning, which we were unable to implement in the present study. In addition, various other variables such as intelligence levels and ADHD medication use have been shown to be important factors in the validity of T.O.V.A. results (Huang, Chao, Wu, Chen, & Chen, 2007; Weyandt, Mitzlaff, & Thomas, 2002). However, the present study did not control for these particular factors, which possibly accounts for the lack of findings with this tool in the present study.

It is possible the lack of findings with the T.O.V.A. are due to administering the test at different times of the day instead of only in the morning, as is recommended, although not all investigators agree this is important (Hunt, Momjian, & Wong, 2011). An alternate explanation may be that the T.O.V.A. is not a great measure of ADHD symptom severity and instead may simply be utilized as a diagnostic aid to provide further evidence for diagnosing ADHD among college students. It seems that self-report measures, such as the ASRS are more useful in identifying students who may be at a greater risk for depression and anxiety due to greater ADHD symptom severity. Finally, given the T.O.V.A. has not been used to predict college adjustment among ADHD students, these findings preliminary suggest it is unrelated to these outcomes.

Impulsivity and Emotion Dysregulation in Relation to Psychosocial and Academic Functioning. Another area of interest was the relationship between impulsivity to psychosocial and academic functioning. There are many studies that show a link between impulsivity and ADHD (Barnhart & Buelow, 2017) as well as impulsivity and substance use and associated consequences (Kollins, 2003). Specifically, as operationalized in the present study, there have been studies that have found a significant relationship between the UPPS-P Positive Urgency subscale (i.e., impulsivity) and alcohol use (Adams, 2012). However, less is known about the UPPS-P and college adjustment measures. In addition, a study by McCarty et al. (2017) assessed the UPPS-P in relation to alcohol use and consequences. These investigators found that impulsivity (i.e., positive urgency) predicted academic/occupational problems and physiological dependence problems among college students engaging in substance use (McCarty et al., 2017).

While there are many ways to measure impulsivity, the present study used a shortened version (SUPPS-P) to examine the relationship of positive urgency to psychosocial and academic adjustment. Of note, there is less research on the direct link of impulsivity as measured by the SUPPS-P to psychosocial and academic functioning compared to other measures of impulsivity. Interestingly, one study found that among college undergraduates, positive urgency on the SUPPS-P was associated with problematic alcohol use, drug use, binge eating, and pathological gambling (Cyders et al., 2014). However, a recent literature search revealed no studies to date that have examined the relationship of impulsivity on the SUPPS-P to psychosocial and academic functioning among a sample of all ADHD college students.

Within this study, analyses using the SUPPS-P, Positive Urgency subscale as a measure of impulsivity failed to find that it was a significant predictor of adjustment measures. Among this sample of all ADHD college students, positive urgency (impulsivity) was not a good predictor of psychosocial and academic adjustment difficulties. Interestingly, impulsivity (positive urgency) was a good predictor of substance-related negative difficulties in this sample; however, it did not predict psychosocial/academic functioning. It may be that positive urgency as a measure of impulsivity has a more direct link to substance use and consequences versus psychosocial and academic difficulties. This supports the prior literature base on the UPPS-P (positive urgency) and substance use (Barnhart & Buelow, 2017). It may be the case that other measures of impulsivity (e.g., delayed discounting) may be more predictive of psychosocial and academic adjustment difficulties among ADHD college students compared to the SUPPS-P. Finally, it is possible that including non-ADHD students in this sample, would have resulted in some significant relationships between impulsivity on the SUPPS-P and psychosocial/academic adjustment.

The SUPPS-P findings related to negative urgency or emotion dysregulation were more noteworthy in regard to psychosocial and academic functioning in this sample of ADHD college students. Prior research has demonstrated a link between emotion dysregulation and substance use and associated consequences. For example, McCarty and colleagues found that emotion dysregulation on the UPPS-P was associated with the following alcohol-related negative consequences: social/interpersonal, self-perception, risky behaviors, and blackout drinking among college students (McCarty et al., 2017). However, less is known about this impact among ADHD students. One study examined emotion dysregulation, measured by an observer-rating scale derived from the Wender-Reimherr Adult Attention Deficit Disorder Rating Scale in a large sample of adults (Corbisiero, Mörstedt, Bitto, & Stieglitz, 2017). Results showed that individuals with ADHD had elevated emotion dysregulation scores and emotion dysregulation was specifically related to elevated ADHD symptoms. The present study examined the relationship of emotion dysregulation to psychosocial and academic functioning among a sample of all ADHD college students.

Various analyses in which emotion dysregulation scores were used to predict psychosocial and academic functioning, resulted in substantial findings within this sample. In fact, negative urgency successfully predicted all of the criterion variables. Specifically, participants who reported higher negative urgency (emotion dysregulation), reported more symptoms of depression (PHQ-9), more symptoms of anxiety (GAD-7), greater difficulty with social adjustment to college (SACQ – Social Adjustment Subscale), lower current GPAs, and greater difficulty with academic adjustment to college (SACQ – Academic Adjustment Subscale). In terms of depression and anxiety, prior literature suggests that emotion dysregulation is commonly an important component of these disorders/symptoms (Marganska, Gallagher, & Miranda, 2013; Mennin, Heimberg, Turk, & Fresco, 2005), providing evidence for this finding. Moreover, it is likely difficult for students who are experiencing current symptoms of emotion dysregulation to succeed academically and they may have more social difficulties. This might be particularly difficult for college students who are already struggling with symptoms of ADHD.

Executive Functioning Deficits in Relation to Psychosocial and Academic Functioning. As noted above in the introduction, there is considerable prior literature discussing the relationship of executive functioning deficits in ADHD to academic and psychosocial difficulties. Specific research studies have assessed executive functioning deficits within ADHD populations. For example, Barkley and Murphy (2011) found that adults diagnosed with ADHD exhibited more deficits in daily life activities than a community control group. In addition, they argued that ratings of executive functioning in daily life accounted for in the BDEFS are more strongly associated with impairments in occupational functioning and general impairment in major life activities as well as ADHD symptoms than executive functioning tests (Barkley, 2011). However, there are few if any studies examining the role of executive functioning deficits in psychosocial

(Weyandt et al., 2017) and academic functioning among college students with a diagnosis of ADHD.

The present study utilized the BDEFS-CA to examine psychosocial and academic functioning in ADHD college students. Findings revealed that executive functioning deficits on the BDEFS-CA predicted both psychosocial and academic functioning. In fact, greater executive functioning deficits significantly predicted more current symptoms of depression and anxiety, more difficulty socially adjusting to college, lower current GPA, and more difficulty academically adjusting to college. These findings indicate that college students with ADHD who report more executive functioning deficits also report more psychosocial and academic functioning difficulties compared to ADHD students with less executive functioning deficits. This is consistent with prior literature that demonstrates difficulties with executive function deficits (e.g., time management and ability to complete tasks) make it difficult for college students to succeed academically (Prevatt et al., 2011). In addition, academic success among ADHD students has been positively correlated with good time management skills (Kaminski, Turnock, Rosén, & Laster, 2006). This finding is consistent with the present study findings in that among ADHD students, those with poor time management skills also reported the most academic difficulties.

Substance Use in Relation to Psychosocial and Academic Functioning

Next, the current study measured the potential impact of substance use on psychosocial and academic functioning within this sample. Prior studies have demonstrated a clear link between greater quantity and frequency of substance use and difficulties in psychosocial and academic outcomes among college students.

Specifically, heavy alcohol consumption among college students has been connected to academic difficulties and negative social-interpersonal consequences (Read et al., 2006). However, when examining this relationship within this all ADHD student sample, evidence for this relationship was not found. Surprisingly, current alcohol consumption and binge drinking status did not predict any of the psychosocial and academic functioning variables. A possible explanation is that among ADHD students there are many unique factors (i.e., severity of symptoms, emotion dysregulation, and executive functioning deficits) determining how well they are functioning, so it is harder to identify heavy drinking as significant. Among ADHD college students, these specific factors may better predict psychosocial and academic functioning, while general risk factors better predict alcohol use and consequences. In addition, some research has highlighted the perception of normalization of alcohol use due to peer norms and peer pressure among college students in general (Knee & Neighbors, 2002). This can lead to the misperception that heavy drinking is a norm in college and does not lead to negative academic and especially psychosocial consequences. This notion is supported through some of the qualitative data collected from this study, demonstrating that many of the participants did not believe that substance use was any differentially associated with difficulties among students with or without ADHD and did not affect psychosocial/academic outcomes.

In addition, some prior studies have shown a link between heavier marijuana use and academic difficulties; however, this relationship is complicated and often indirectly influenced by other variables (e.g., executive functioning and working memory). Specifically, research demonstrates negative effects of marijuana use on attention and executive functioning, especially among heavy users compared to light users in college settings (Pope, & Yurgelun-Todd, 1996). Moreover, greater marijuana use among college students has been linked to poor class attendance, lower GPA, and lower graduation rates among college students (Arria et al., 2015). There is limited research examining the relationship of marijuana use to psychosocial outcomes among college students with a diagnosis of ADHD. Moreover, there is a lack of research on the effects of Other illicit drug use on college functioning.

The present study added to the available research by examining marijuana and other illicit substance use in relation to psychosocial and academic functioning among ADHD college students. Surprisingly, as was the case with alcohol use, current marijuana use, classification as a regular marijuana user, and current other illicit drug use did not directly predict any of the psychosocial and academic functioning variables. Similarly, to the findings with alcohol use, it is likely that marijuana is more related to specific drug-use consequences rather than broader psychosocial/academic difficulties in functioning. In addition, as previously mentioned, the limited number of Other illicit drug users likely reduced power in these analyses, perhaps accounting for the lack of significant findings on adjustment measures.

The various substance abuse variables were not predictive of the psychosocial adjustment measures used in this study, which was not expected. None of the use variables were related to reported anxiety or depression scores nor did they predict GPA or measures of academic or social adjustment to college. However, substance use variables were related to associated negative consequences but largely independent of these psychosocial outcomes, which were more related to ADHD symptoms. These results are somewhat like those found in the pilot study of college students at the same university which indicated that although there is a high comorbidity of depression and substance use, the risk for substance abuse among ADHD students was largely independent from depression (Mochrie et al., 2018). Further, these findings do suggest a clear difference between general and ADHD specific predictors among ADHD college students in terms of functioning. Specifically, ADHD symptoms and related factors seem to be the best predictors of psychosocial and academic difficulties. Specifically, the best predictors of adjustment measures in the present sample were severity of ADHD symptoms, negative urgency or emotional dysregulation and reported deficits in executive functioning. The issues of substance-related consequences and psychosocial/academic problems are not necessarily separate in that both ultimately seem to be related to negative consequences, although the predictors that are most related are dependent on the consequences being predicted. Of note, although alcohol-related consequences were not related to any of the adjustment variables, drug-related consequences were positively correlated with depression (PHQ-9) and academic adjustment problems (SAQC – Academic Adjustment Subscale), $r = .31$, $p < .05$, $r = .35$, $p < .05$, respectively, suggesting some overlap in consequences.

Interaction of ADHD Specific Factors and Substance Use on Psychosocial and Academic Functioning

An important objective of the study was to assess the interaction of ADHD specific factors and substance use in predicting psychosocial and academic functioning. Given that ADHD specific factors, but not current substance use were directly related to psychosocial and academic outcomes, it was important to investigate the interaction of these in predicting college student functioning. It was thought that perhaps the interaction of ADHD factors and substance use would significantly predict psychosocial and academic functioning among ADHD students despite substance use being a poor predictor on its own. As argued earlier, one might expect substance use involvement to have more risk or detrimental effects in this population. Interestingly, these findings were mixed.

In terms of interactions with current alcohol use and binge drinking status, there were some significant findings; however, the majority of these interactions were non-significant. First, there was a significant interaction of higher positive urgency (impulsivity) and more current alcohol use predicting less depression symptoms on the PHQ-9, but only at lower levels of alcohol use. This was not in the expected direction. It is possible that these individuals are engaging in more social activities that include light alcohol use and impulsive decision making which is not necessarily linked with higher depression. In fact, the argument might be made that since these individuals are engaged in more social activities (which may come with more impulsivity/extraversion), they experience less depression symptoms (e.g. lower anhedonia) than those who are not socially involved.

Second, the interaction of higher executive functioning deficits on the BDEFS-CA and heavier alcohol use did significantly predict lower current GPA in this sample, with the greatest effect at heavy levels of alcohol use. Further, the interaction of higher executive functioning deficits on the BDEFS-CA and binge drinking status also predicted lower current GPA. These findings were in the expected direction and suggest that among ADHD college students those with a combination of problematic alcohol use (including binge drinking) and greater executive functioning deficits also have increased academic problems in terms of GPA. Prior research has shown that executive functioning deficits and excessive alcohol use separately can lead to lower GPA's among college students (Skidmore et al., 2016). These findings expand on that research by demonstrating that ADHD students who experience more executive functioning deficits and also are consuming greater amounts of alcohol are at a higher risk for poor GPAs and possible academic probation or suspension compared to ADHD students who do not drink or drink less.

In terms of interactions with current marijuana use, there were some significant findings; however, the majority of these interactions were also non-significant. First, the interaction of higher executive functioning deficits on the BDEFS-CA and more current marijuana use did significantly predict lower current GPA in this sample, but only at moderate and high levels of marijuana use. This was also true for the interaction of the BDEFS-CA and classification as a regular marijuana user. It appears that academics (i.e., GPA) are the most negatively affected by an interaction of executive functioning deficits and moderate or heavy use of marijuana. This finding is important because it illustrates the connection between marijuana use and executive functioning deficits and the detrimental effects this can have on ADHD college students.

Moreover, the interaction of lower CE (i.e., greater impulsivity) on the T.O.V.A. and marijuana use as well as the interaction of OE (i.e., more difficulty with focus and vigilance) on the T.O.V.A. and marijuana use significantly predicted lower current GPA within this sample, but only at high levels of marijuana use. It appears that the combination of greater marijuana use (or being classified as a regular marijuana user) and higher impulsivity is important for predicting ADHD college students who struggle with academics (i.e., GPA), particularly among those using higher levels of marijuana. Some research has demonstrated a link between more frequent marijuana use and greater impulsivity among young adults (Piechatzek et al., 2009) as well as with ADHD college students (Weyandt et al., 2013b). It may be that there is an overlap between marijuana use and impulsivity among ADHD college students that best predicts issues with GPA. These findings add to the current literature in this area by expanding previous studies that only examine impulsivity and attention problems and marijuana use separately to predict GPA among college students. Due to these findings, it seems particularly important to pay attention to ADHD students who struggle with both marijuana use and impulsivity/attentional problems. It is likely that marijuana use exacerbates symptoms of difficulty with focus and vigilance which can lead to poor grades and GPA among ADHD college students.

In summary, various moderation analyses were conducted to determine the influence of substance use variables (i.e., current alcohol use, binge drinking status, and current marijuana use) on the relationship between ADHD specific factors and psychosocial/academic functioning. There were minimal moderation findings in terms of current alcohol use with only one significant interaction effect. Specifically, there was a significant interaction of higher executive functioning deficits on the BDEFS-CA and binge drinking status predicting lower current GPA in this sample. In terms of marijuana use, there were several moderation analyses predicting GPA that were significant. Specifically, the interactions of higher impulsivity (T.O.V.A. CE), more difficulties with focus and vigilance (T.O.V.A. OE), and more executive functioning deficits (BDEFS-

CA), with greater marijuana use, all significantly predicted lower current GPA. Although these few findings should be considered tentative given the number of analyses conducted, they formed a meaningful pattern.

In conclusion, there was some evidence for the interaction of ADHD specific predictors with substance use (particularly marijuana) to predict lower college GPA within this sample of ADHD college students. However, one might have expected even more evidence of such interactions. The lack of moderation findings of ADHD specific factors interacting with substance use to predict academic and psychosocial outcomes within the sample might also be explained due to limited statistical power. The study sample size (N = 66), likely made it difficult to detect significant moderation effects. It is likely that some moderation analyses that approached significance stated below would have been detected with a larger sample. Specifically, the interaction of more T.O.V.A. OE (focus/vigilance problems) with current alcohol use might have predicted lower GPA; the interaction of the ASRS (severity of symptoms) with binge drinker status might have predicted more academic adjustment problems on the SACQ; the interaction of the ASRS (severity of symptoms) with current marijuana use might have predicted lower GPA; finally, the interaction of the SUPPS-P Negative Urgency Subscale (emotion dysregulation) with current marijuana use might have predicted lower GPA with a larger sample size.

Study Strengths and Limitations

The present study was seen as having several strengths. First, while prior studies of ADHD and substance abuse risk have primarily used self-report data to define ADHD college student participants, the present study included soliciting parent report, through which 90% of participants were confirmed as having been diagnosed with ADHD. In addition, current diagnostic status was established via a structured (SCID-5) clinical interview. These measurements increase the likelihood that this was a valid sample of college students who were previously diagnosed with ADHD. In terms of actual measures, this study was one of the first to also include an objective behavioral assessment (T.O.V.A.) to analyze ADHD symptom impairment rather than relying solely on self-report data. Also, in examining predictors of substance use, the present study incorporated multiple general predictors and used several covariates throughout the analyses, including a history of conduct problems, which other studies have been criticized for not including. Further, this was the first study of its kind to examine multiple predictors of substance use and associated consequences within a single model.

The current study also extended previous literature findings on ADHD college students by examining ADHD specific predictors of multiple academic and psychosocial outcomes. Further, interactions between ADHD specific predictors and substance use variables on psychosocial and academic outcomes was assessed, which has not been previously examined within an all ADHD college student sample. Finally, participants were provided an opportunity to answer several qualitative questions allowing them to discuss what they believed about ADHD and substance use as well as what ADHD students need to succeed in college. This allowed for a preliminary assessment of ADHD college student's knowledge about the disorder and their personal risk factors.

While the study had many strengths there were also several limitations. First, the current sample was comprised of mostly freshman and sophomore, Caucasian students from a local university; therefore, the findings may not generalize to other college populations. Participants also self-selected to be in the study and may represent a unique group of college students with ADHD. Second, the substance abuse measures were self-report in nature; however, this is common practice within studies of college student substance use and there were some validity checks on the survey data. Similarly, the measures of psychosocial and academic adjustment difficulties also involved self-report, most notably GPA. This might have impacted the validity of these results. In one case (i.e., sensation seeking) as measure was found to have inadequate reliability to be useful. Third, the study design was cross-sectional in nature limiting understanding of correlational relationships (e.g., impulsivity and marijuana use) which could be bi-directional. The present study is unable to clarify how ADHD might contribute developmentally to increased substance abuse risk, presumably through general predictors such as history of substance use, expectancies and peer influences. Moreover, because the study used a within-subjects design to assess only college students with ADHD it was not able to address differences or relationships that might exist if non-ADHD students were included. Lastly, while the sample size (N = 66) was above the suggested 59 participants from the G-power analysis, some of the multiple regression and moderation analyses may have lacked sufficient power due to lower numbers of users of specific substances, such as Other illicit drugs. Given these limitations the study findings may not be generalizable to all college students. Also, given the many analyses performed, it is possible that some significant relationships may have arisen due to experiment wise error.

Significance of Study Findings

Overall, the current study was designed to examine the role of general and

ADHD specific predictors of substance use and consequences within a sample of all ADHD college students. There were several major significant findings. *Significant Finding #1*: The primary findings indicated that general predictors (i.e., substance use history, history of conduct problems, peer influence, and positive expectancies) were the best predictors of current substance use and associated negative consequences within the sample. Individuals with ADHD, similar to non-ADHD students, have an increased risk for substance abuse and associated consequences due to elevations in these general factors.

Significant Finding #2a: When examining the contribution of at ADHD specific factors (i.e., severity of ADHD symptoms, impulsivity, emotion dysregulation, and executive functioning deficits), they were generally poor predictors of substance use in an all ADHD sample. It is likely that ADHD factors operate developmentally through the general factors to produce an increased risk for substance use and associated consequences. In addition, these major findings indicate that, like college students without ADHD, college students with ADHD who have higher general substance use predictors are more likely to engage in more frequent and heavy substance use in college. Perhaps this outcome is not surprising in that it has been well documented in prior studies assessing general predictors of college student substance use (Skidmore et al., 2016).

Significant Finding #2b: There were some findings that ADHD specific factors (i.e., severity of symptoms on the ASRS, impulsivity/emotion dysregulation on SUPPS-P, and executive functioning deficits on the BDEFS-CA) significantly predicted substance use consequences, rather than current use. Given that some of the ADHD specific factors were successful in predicting substance use negative consequences it seems imperative to consider ADHD students with greater symptoms, higher impulsivity, higher emotion dysregulation, and higher executive functioning deficits to be at a greater risk for substance-related problems. Of note, alcohol-related consequences on the RAPI and drug-related consequences on the SIP-D were strongly correlated with each other, $r = .64$, $p < .001$. This might reflect the high comorbidity of alcohol use and drug use problems. It seems that ADHD specific factors are important in determining who is at a greater risk for experiencing substance-related consequences associated with their use and by implication developing a substance use disorder.

*Significant Finding #3*a: Findings revealed that emotion dysregulation (negative urgency) and executive functioning deficits both significantly predicted all of the college adjustment variables. Specifically, students with higher emotion dysregulation also struggled with more symptoms of depression/anxiety as well as social and academic functioning. This finding makes sense given that emotion dysregulation is often associated with these different constructs (Marganska et al., 2013; Mennin et al., 2005). College students with ADHD who struggle more in these areas are at a greater risk of psychosocial and academic concerns compared to ADHD students without difficulties in these areas. Moreover, students with more executive functioning deficits also reported more psychosocial and academic adjustment difficulties. These findings are understandable given that individuals with executive functioning difficulties have problems in many of these areas in general (Yücel et al., 2007). College students with ADHD are likely at a higher risk for these difficulties due to other complications such as substance use difficulties.

Significant Finding 3b: In addition, study findings revealed that higher severity of symptoms on the ASRS predicted more current symptoms of depression/anxiety as well as more academic adjustment difficulties on the SACQ. It seems that among this sample of ADHD college students, severity of both inattentive and hyperactive symptoms best predicts symptoms of emotional disorders and academic difficulties. As stated before, there are other factors such as emotion dysregulation and executive functioning deficits that are good predictors of these outcomes. However, it seems that ADHD symptoms are unique in that they considerably contribute to psychosocial and academic adjustment problems in college. It is likely those with ADHD who have a greater severity of symptoms have acquired fewer coping strategies to help reduce these difficulties.

Significant Finding #4: Overall, findings revealed that although related to substance use negative consequences, substance use was not a good predictor of psychosocial and academic outcomes in this ADHD sample. The finding was somewhat surprising, given that other research has linked substance use among students to similar college adjustment problems (Mesman, 2015; Messina et al., 2014). However, research with ADHD samples is mixed, with a pilot study using the same college student sample as the present study finding that although ADHD and substance use are linked, they reflect a unique and independent risk for college adjustment problems, specifically depression (Mochrie et al., 2018). It may be best to consider substance use and avoiding associated consequences as an additional adjustment variable which ADHD college students must navigate.

Significant Finding #5: The current study also assessed the interaction of current substance use and ADHD specific factors on psychosocial and academic functioning. Findings indicated that the interactions of alcohol and especially marijuana with various ADHD specific factors did indeed predict GPA. These findings indicate that substance use is important, at least in terms of predicting GPA when interacting with ADHD specific factors among college students. Although these findings should be considered tentative, they provide evidence of possible greater risk of substance use due to interaction with ADHD factors as hypothesized.

Clinical Implications of the Study Findings

There are various findings from the present study that might be used to inform clinical assessment and treatment of ADHD college students. First, in regard to substance use risk, prevention efforts should be aimed at identifying individuals at a greater risk due to the general substance use predictors identified. Importantly, both students with and without ADHD should be screened for these general predictors as they are associated with increased risk for substance use and consequences in the general college population. However, it seems imperative to identify those with ADHD who score highly on these general predictors given their high risk for substance-related consequences as well as their lack of awareness of their increased risk for poor outcomes as evidenced by some of the qualitative findings in the study.

The study findings demonstrate the importance of substance use history when attempting to identify ADHD college students that may be at a higher risk for alcohol and other drug use, binge drinking, and substance-related negative consequences in college. As part of orientation to college, preferably during Freshman year, it could prove useful to ask individuals about their substance use history through short questionnaires/surveys and offer secondary prevention resources for those that engaged in substance use at a young age. Moreover, students with ADHD who opt to use disability support services might also be screened with these questions to ensure they are given the proper psychoeducation and resources about their risk level for alcohol and other drug abuse. This could be used as form of prevention to help beginning college students increase their awareness of substance abuse risk as well as their own personal risk level.

Many studies suggest that prevention efforts to increase awareness and reduce substance use are useful for college students in general, especially with using personalized feedback about substance abuse risk level (Skidmore et al., 2016). It would seem particularly important for ADHD students, as they are inherently at a greater risk due to this diagnosis than their peers without ADHD (Mochrie et al., 2018; Molina & Pelham, 2014). In addition to substance use history, colleges should find ways to identify entering ADHD students that have higher/increased other general predictors of substance. In particular, the present findings suggest that positive alcohol and marijuana expectancies regarding use might be targeted to reduce associated risk that these individuals have for substance use and related negative consequences. These questions could also be easily implemented into a survey and incorporated into personalized feedback for incoming Freshman students. Moreover, ADHD students should receive normative feedback about peer use, due to many students believing their peers are using substances at much higher rates than in reality (Boot et al., 2013). Finally, individuals with a history of conduct disorder problems are at a much greater risk of developing substance use issues in college. Again, utilizing a short questionnaire, such as the Conduct Problems Questionnaire used in this study, could help capture this risk and be given as part of a personalized feedback intervention to incoming students with ADHD.

Interestingly, the present study did not find that ADHD specific factors were good predictors of substance use. However, there were significant findings with substance use consequences, suggesting participants with more ADHD-related issues were also those that experience more substance-related negative consequences. It may be that consequences from substance use such as academic and social difficulties overlap with those of ADHD in this sample. The findings indicate that not only should prevention efforts target what are considered more general predictors of substance abuse risk among college students they should also target ADHD specific factors among these students to help reduce substance-related consequences. It is recommended that all students who have received a diagnosis of ADHD be assessed for both general and specific ADHD factors predicting substance use and consequences to ensure that they are given adequate psychoeducation as to their risk level. With this information ADHD students may be more likely to make healthier choices regarding their substance use, which will likely reduce their chances of experiencing associated negative consequences. Moreover, this might allow for targeted interventions aimed at reducing the risk of substance use and associated consequences among ADHD students.

An emerging literature is now developing that CBT strategies are helpful in developing coping strategies and reducing symptoms of ADHD among college students (Anastopoulos & King, 2015; Anastopoulos, King, Besecker, O’Rourke, Bray, & Supple, 2018; Young, Moghaddam, & Tickle, 2016). It may prove useful to incorporate substance use interventions into these existing programs. For example, these proposed interventions might take the form of groups in a counseling center setting that could incorporate substance abuse modules and harm reduction approaches into coping skills programs for ADHD students.

In addition, perhaps combining psychoeducation and harm-reduction approaches would help ADHD students explore and decrease their substance use and possible negative consequences associated with this use. For example, the Brief Alcohol Screening and Intervention for College Students (BASICS) has been shown to be effective at reducing alcohol use, binge drinking, and alcohol-related consequences among college students in general (Dimeff, 1999). Perhaps combining this intervention with ADHD coping skills and/or coaching would be useful for ADHD students. This may be particularly useful for incoming freshman with a diagnosis of ADHD who are at a higher risk for substance abuse problems based on general predictors previously mentioned. Moreover, the present study findings suggest that it is possible that many students seeking help for ADHD difficulties are actually experiencing ADHD symptoms and substance use problems simultaneously and programming should be aimed at addressing both of these issues. This is demonstrated further by some of the moderation analyses of the present study that indicate a combined risk of marijuana use and ADHD specific factors for lower GPA, which is discussed in detail further below.

In terms of college adjustment, ADHD specific factors were excellent predictors of psychosocial outcomes. Given these results, careful attention must be given to severity of symptoms, emotion dysregulation, and perceived deficits in executive functioning when assessing risk for psychosocial and academic problems among ADHD college students. The findings related to depression/anxiety indicate the need for affective interventions, especially among ADHD students who tend to report increased emotion dysregulation. These could take the form of individual therapy or groups within a college student counseling center.

Prior research has specifically shown the benefit of interventions to reduce emotion dysregulation for college students that might be implemented. For example, in a small sample (N = 33) of college students who were diagnosed with ADHD, those who completed an eight-week DBT skills training program designed specifically for ADHD, showed greater treatment response/clinical recovery rates on ADHD symptoms and executive functioning, and greater improvements in quality of life compared to those in treatment as usual (Fleming, 2015). DBT skills primarily function to reduce emotion dysregulation (Linehan, 1993); however, this study provides preliminary evidence that DBT can be effective at reducing overall symptoms and deficits associated with ADHD, which could also be implemented into college counseling centers.

Additionally, it may be useful to incorporate specific executive functioning training into ADHD coaching programs to address deficits in psychosocial and academic functioning among these students. In fact, research has demonstrated the efficacy of ADHD coaching programs to improve symptoms and executive functioning. ADHD coaching is an intervention that complements and specifically targets the core impairments of ADHD such as planning, time management, goal setting, organization and problem solving. In a recent literature review by Ahmann and colleagues, ADHD coaching was found to improve ADHD symptoms and executive functioning among college students (Ahmann, Tuttle, Saviet, & Wright, 2018). In addition, benefits such as improved well-being, maintenance of gains, and participant satisfaction were found, suggesting this intervention would be extremely useful for ADHD college students.

As mentioned before, it may be useful to conduct a brief assessment on these ADHD specific factors when ADHD students enter college. It could be suggested that all ADHD students entering college attend at least one counseling session, where they consider the benefit of registering with the Department of Disability Services and during which any specific risks could be better identified. Many students do not utilize their campus department of disability services, with some studies suggesting that only 41.5% of ADHD students are registered with this service (Anastopoulos et al., 2018). This suggested technique might drastically improve this number. Most importantly, this might help identify individuals with comorbid depression and/or anxiety who are at an even greater risk for adjustment problems. It is suggested that individuals who score high in these domains be given additional assistance to prevent increased risk for psychosocial and academic difficulties.

Prior studies have found that CBT strategies are helpful in developing coping strategies and reducing symptoms of ADHD among college students (Young, Moghaddam, & Tickle, 2016; Anastopoulos & King, 2015). Perhaps adding components/ module that specifically address symptoms of impulsivity, emotion dysregulation, and executive functioning deficits would be particularly helpful in reducing this risk among ADHD college students. Further, it would be useful for these students to receive ongoing monitoring and support above and beyond accommodations. Findings from the qualitative data gathered from the study also support this notion, as many of the participants asserted that they would find coping skills, more resources, and even

ADHD specific groups to be helpful. Lastly, Hinshaw (2018), argues that the aim of treatment should be to enhance competencies rather than just reduce symptoms, which might better fit the needs of this at-risk group.

The interaction findings of ADHD related impairment on the T.O.V.A. with marijuana use on GPA has many implications as society's attitudes regarding marijuana use have become more liberal, yet regular or heavy use may pose greater risk to ADHD individuals. One might speculate why a similar interaction was not found for academic difficulties on the SACQ; perhaps the more subjective nature of self-reported academic difficulties is a factor. It may be that ADHD students do not believe they are as impaired as they actually might be in terms of academic functioning. Prior research has demonstrated that many ADHD students have a lack of awareness as to the impact their ADHD diagnosis can have on college adjustment (Anastopoulos & King, 2015). This has implications for preventive educational programs (i.e. psychoeducation about the combined risk) as well as treating both ADHD and comorbid substance.

Future Research Implications and Directions

Clearly, further research is needed on the topic of ADHD and substance abuse risk and future studies should seek to replicate these findings with larger and more diverse samples. Studies should seek to include a high level of methodological rigor when examining ADHD college students. It is recommended that parent reports be collected for as many participants as possible, as was accomplished in the present study. Moreover, future studies might seek to implement more psychoeducational testing both to confirm ADHD diagnosis and provide performance measures of symptom impairment. In addition, longitudinal studies are needed to best understand the impact of ADHD and substance use on college adjustment. ADHD specific and general factors in relationship to substance use and consequences must be examined over time. With a larger sample, possible gender differences could also be assessed.

Further work is also needed regarding the effectiveness of stimulant medication in this population and differences between ADHD individuals who are taking stimulant medication and those who are not should be assessed, as well as combined treatment with CBT interventions. Preliminary analyses in the present study did not find medication use was related to psychosocial outcomes. It will be important to continue to distinguish taking medication as prescribed versus misusing stimulant medication when examining this population. The latter use was infrequent in this group but did relate to other drug use. Future studies should also seek to better measure prescription stimulant misuse among ADHD students. Perhaps assessing how many times in the last year individuals engaged in this behavior and accompanying motives would likely provide a better understanding of this issue.

In terms of general versus ADHD specific factors, researchers are encouraged to continue finding unique ways to measure these facets which might include different measures of these same constructs. Future studies might also seek to implement more objective behavioral assessment when examining ADHD college students. For example, measures of processing speed and working memory may be useful for future research in this area. Due to the poor reliability of the sensation seeking measure in this sample, future studies should attempt to utilize other measures of sensation seeking among college students to determine its relationship to substance use and general functioning.

In addition, it may prove useful to examine differences between ADHD students who are consuming alcohol versus those that are abstinent to determine differences in functioning. Specifically, with a larger sample, several groups (i.e., light, moderate, heavy drinkers) might be created to assess these differences among ADHD students. This should also be done with marijuana use, considering it was a major study variable and was significant in predicting substance use consequences as well as GPA. It could also prove useful to examine other facets of psychosocial and academic functioning in more detail such as, attendance rates, study time, friend groups, etc. Future studies should continue to examine differences within ADHD college students rather than rely solely on assessment of differences between ADHD and non-ADHD students. However, including non-ADHD students may be warranted in dimensional analyses of general and ADHD specific predictors of substance use and consequences as well as college adjustment outcomes to expand variable ranges in these domains.

Given that research including the present study indicates shared variance between ADHD symptoms, substance use, and a history of conduct problems, it may be useful to consider underlying dimensions that are best predictors of college student adjustment. Interestingly, some research indicates that conceptualizing ADHD (or other mental health diagnoses) as a manifestation of liability factors better accounts for comorbid disorders and resultant symptoms/problems (Krueger & Markon, 2006). For example, it may be that conduct problems and externalizing disorders operate as developmental risk factors for increased ADHD symptoms which in turn may relate to earlier onset of substance use. Some research demonstrates a high comorbidity of externalizing traits and ADHD traits, with externalizing traits in childhood predicting

ADHD traits in early adolescence, which in turn predict more externalizing traits in adulthood (Kuja, Lichtenstein, D'Onofrio, & Larsson, 2015). Clearly, this relationship is complex and future studies should examine multiple traits in relation to substance abuse among ADHD and non-ADHD college students. Future studies could seek to examine dimensional models of these constructs which might include examining subclinical populations of ADHD students as well as attempting to capture more variability in current substance use among ADHD and non-ADHD students with a larger sample.

Finally, future studies might design and evaluate prevention and treatment efforts specifically geared towards incoming ADHD students. Perhaps identifying an acceptable way to identify ADHD individuals who are at a higher risk for substance abuse and/or college adjustment difficulties upon entering college would be useful. Interventions should also incorporate substance abuse psychoeducation into ADHD skills coaching interventions to test the impact of these interventions on substance use and associated consequences. In conclusion, the available studies of college students with ADHD examining their adjustment are preliminary at best. More research is needed to confirm and extend the present study findings to best help college students with ADHD who are clearly experiencing higher rates of overall difficulties compared to non-ADHD peers.

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APPENDIX A: IRB APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board
4N-64 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/ORIC/irb**

Notification of Initial Approval: Expedited

From:	Social/Behavioral IRB
To:	Kirk Mochrie
CC:	Tony Cellucci Kirk Mochrie
Date:	11/8/2017
Re:	UMCIRB 17-002289 ADHD College Student Survey

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 11/7/2017 to 11/6/2018. The research study is eligible for review under expedited category #7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).
The approval includes the following items:

Name	Description
ASRS.docx	Surveys and Questionnaires
Debriefing Script.docx	Interview/Focus Group Scripts/Questions
Demographics Form.docx	Surveys and Questionnaires
Dissertation Proposal	Study Protocol or Grant Application
Flyer	Recruitment Documents/Scripts
Intro to study script.docx	Interview/Focus Group Scripts/Questions
Lab Script.docx	Interview/Focus Group Scripts/Questions
Mochrie - Dissertation Informed Consent.doc	Consent Forms
Mochrie - ROI.doc	Consent Forms
Peer Substance Use.docx	Surveys and Questionnaires
Phone Script.docx	Interview/Focus Group Scripts/Questions
Qualitative Questions.docx	Surveys and Questionnaires
Resource Packet	Additional Items
SCID-5 ADHD	Standardized/Non-Standardized Instruments/Measures
Self report diagnosis and treatment history.docx	Surveys and Questionnaires
Short Index of Problems Drug Use (SIP-D).docx	Surveys and Questionnaires
Survey Script.docx	Interview/Focus Group Scripts/Questions
The Barkley Adult ADHD Rating Scale - Other report.docx	Surveys and Questionnaires
The Barkley Adult ADHD Rating Scale.docx	Surveys and Questionnaires
The Barkley Deficits in Executive Functioning Scale.docx	Surveys and Questionnaires
The Drug Use History Questionnaire.docx	Surveys and Questionnaires
The Generalized Anxiety Disorder.docx	Surveys and Questionnaires
The Marijuana Expectancies Questionnaire.docx	Surveys and Questionnaires
The Patient Health Questionnaire.docx	Surveys and Questionnaires
The Quantity Frequency Index for Alcohol (QFI-Alcohol).docx	Surveys and Questionnaires
The Quantity-Frequency Index (QFI) -other drugs.docx	Surveys and Questionnaires
The Revised Alcohol Expectancy Questionnaire.docx	Surveys and Questionnaires
The Rutgers Alcohol Problem Index (RAPI).docx	Surveys and Questionnaires

The Sensation Seeking Scale.docx	Surveys and Questionnaires
The Short UPPS.docx	Surveys and Questionnaires
The Structured Clinical Interview for DSM - Conduct problems.docx	Surveys and Questionnaires
The Student Adaptation to College Questionnaire.docx	Surveys and Questionnaires

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

APPENDIX B: EXPANDED RESULTS OF NON-SIGNIFICANT MODERATION ANALYSES

Interaction of ADHD Specific Predictors and Current Alcohol Consumption

In order to assess the interaction of current alcohol consumption and ADHD specific predictors (*Aim 4*, Hyp 3), moderation analyses (Hayes, 2013) were conducted to determine the degree to which current alcohol consumption influences the relationship between ADHD specific predictors (i.e., ASRS, T.O.V.A., SUPPS-P, and BDEFS-CA) and psychosocial and academic functioning. These analyses were run using the PROCESS Macro and SPSS (Version 24, Greenville, NC), using a bootstrapping technique generating 5,000 random samples with replacement from the data set. Demographic covariates and history of conduct problems were examined in relationship to psychosocial and academic functioning. Due to the majority of these covariates being correlated with psychosocial and academic outcomes, all moderation analyses controlled for age, sex, current year in college, and history of conduct problems, regardless of the significance of the model. If the moderation model was significant, it was further examined to determine if there was a significant interaction effect. The specific statistics of the interactions for each ADHD specific predictor and substance are displayed in a table under each section.

Interaction of ASRS and Current Alcohol Consumption. First, the interaction of the ASRS (i.e., self-reported severity of ADHD symptoms) and current alcohol use on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the ASRS in combination with more current alcohol consumption would predict more problematic psychosocial and academic functioning in the sample (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the ASRS, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 6.905, p < .001, R^2= .455. However, the interaction of the ASRS and current alcohol consumption was not significant in predicting depression symptoms on the PHQ-9.

Moderation analysis similarly revealed a significant overall model for the ASRS, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 4.106, p < .01, R^2= .331. However, the interaction of the ASRS and current alcohol consumption was not significant in predicting anxiety symptoms on the GAD-7. Moderation findings did not reveal a significant overall model of the ASRS, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.725, p >.05, R^2= .172.

In terms of academic functioning, moderation findings did not reveal a significant overall model of the ASRS, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 2.117, p > .05, R^2= .256. Finally, moderation findings did not reveal a significant overall model of the ASRS, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 1.998, p > .05, R^2= .194. Specific results of all the moderation analysis with the ASRS can be found in *Table 1* below.

Table 1. Moderation, ASRS and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.001	.001	-1.045	*p* = .300
GAD-7 (Anxiety)	-.001	.001	-.521	*p* = .605
SACQ – Social Adjustment	.001	.002	.094	*p* = .925
GPA	-.000	.000	-1.009	*p* = .319
SACQ – Academic Adjustment	-.046	.034	-1.359	*p* = .180

In summary, there were minimal findings when testing the interaction of the ADHD symptoms (as measured by ASRS) and current alcohol consumption on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes.

Interaction of T.O.V.A. Variables and Current Alcohol Consumption. Next, the interaction of the T.O.V.A. variables (i.e., RTV, RT, CE, and OE) and current alcohol use on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the T.O.V.A. variables in combination with more current alcohol consumption would predict more problematic psychosocial and academic functioning in the sample. First, I report on the T.O.V.A. RTV (consistency), followed by RT (speed), CE (impulsivity), and OE (focus and vigilance). It was hypothesized that lower standard scores on the T.O.V.A. variables (i.e., less RTV, slower RT, more CE, and more OE) would interact with current alcohol use to predict more psychosocial and academic functioning difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the T.O.V.A. RTV, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 3.135, $p < .01$, $R^2 = .275$. However, the interaction of the T.O.V.A. RTV and current alcohol consumption was not significant in predicting depression symptoms on the PHQ-9. Of note, being female was a significant covariate ($p = .021$), with greater history of reported conduct problems approaching significance ($p = .057$). Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.742, $p > .05$, $R^2 = .174$. Moreover, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.074, $p > .05$, $R^2 = .115$. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.407, $p > .05$, $R^2 = .186$. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .381, $p > .05$, $R^2 = .044$. Specific results of moderation analyses with the T.O.V.A. RTV can be found in *Table 2* below.

Table 2. Moderation, T.O.V.A. RTV and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.001	.001	.644	p = .522
GAD-7 (Anxiety)	.001	.000	1.130	p = .263
SACQ – Social Adjustment	.000	.001	.098	p = .923
GPA	-.000	.000	-1.009	p = .319
SACQ – Academic Adjustment	.001	.001	1.003	p = .320

In terms of the T.O.V.A. RT (speed), moderation findings revealed a significant overall model of the T.O.V.A. RT, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.945, $p < .05$, R^2= .512. However, the interaction of the T.O.V.A. RT and current alcohol consumption was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .008), with greater history of reported conduct problems approaching significance (p = .060). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.500, $p > .05$, R^2= .153. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.218, $p > .05$, R^2= .128. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.284, $p > .05$, R^2= .173. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .283, $p > .05$, R^2= .033. Specific results of moderation analyses with the T.O.V.A. RT can be found in *Table 3* below.

Table 3. Moderation, T.O.V.A. RTV and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.000	.001	-.301	p = .765
GAD-7 (Anxiety)	.000	.001	.414	p = .681
SACQ – Social Adjustment	.000	.001	.029	p = .977
GPA	.000	.000	.597	p = .554
SACQ – Academic Adjustment	.001	.001	.728	p = .470

Next, the T.O.V.A. CE (impulsivity) was examined using the PROCESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. CE, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.857, $p < .05$, R^2= .256. However, the interaction of the T.O.V.A. CE and current alcohol consumption was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .009), with greater history of reported conduct problems approaching significance (p = .062). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.517, p > .05, R^2= .155. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.023, p > .05, R^2= .120. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.566, p > .05, R^2= .203. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .223, p > .05, R^2= .026. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 4* below.

Table 4. Moderation, T.O.V.A. CE and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.000	.001	.340	*p* = .180
GAD-7 (Anxiety)	.000	.001	-.089	*p* = .930
SACQ – Social Adjustment	-.001	.001	-.523	*p* = .603
GPA	.000	.000	1.022	*p* = .313
SACQ – Academic Adjustment	.000	.001	.290	*p* = .773

Lastly, the T.O.V.A. OE (Focus and Vigilance) was examined using the PROOESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. OE, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.848, $p < .05$, R^2= .256. However, the interaction of the T.O.V.A. OE and current alcohol consumption was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .010), with greater history of reported conduct problems approaching significance (p = .065). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.505, $p > .05$, R^2= .154. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.015, $p > .05$, R^2= .109. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.779, $p > .05$, R^2= .225. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .283, $p > .05$, R^2= .033. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 5* below.

Table 5. Moderation, T.O.V.A. OE and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.000	.001	.256	$p = .799$
GAD-7 (Anxiety)	.000	.001	.445	$p = .658$
SACQ – Social Adjustment	.000	.001	.019	$p = .708$
GPA	.000	.000	1.685	$p = .099$
SACQ – Academic Adjustment	.001	.001	.804	$p = .425$

In summary, there were minimal findings when testing the interaction of the T.O.V.A. variables and current alcohol consumption on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes. This remained true even after testing the dichotomized T.O.V.A. variables (i.e., within normal limits or not). This mirrored prior findings within Aim 3 in which TOVA variables were not associated with ADHD symptoms and not predictive of psychosocial outcomes.

Interaction of Emotion Dysregulation and Current Alcohol Consumption. Next, moderation analyses were conducted to assess the interaction of ADHD specific variables and emotion dysregulation (negative urgency) on the SUPPS-P. It was hypothesized that higher negative urgency scores would interact with more current alcohol use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of negative urgency, with current alcohol consumption as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, *F* (7,

58) = 6.056, $p < .001$, $R^2 = .422$. Contrary to the hypothesis, the interaction of higher negative urgency and more current alcohol consumption was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female emerged as significant covariate in the model ($p = .000$). In addition, moderation findings revealed a significant overall model of negative urgency, with current alcohol consumption as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 2.714, $p < .05$, $R^2 = .247$. When examined further, the interaction of negative urgency and alcohol consumption was not significant in predicting the GAD-7. Of note, being female emerged as a significant covariate ($p = .014$). Moreover, moderation findings revealed a significant overall model of negative urgency, with current alcohol consumption as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 2.473, $p < .05$, $R^2 = .231$. However, upon further review the interaction of negative urgency and alcohol use was not significant in predicting social adjustment on the SACQ.

Similarly, moderation findings revealed a significant overall model of negative urgency, with current alcohol consumption as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 2.633, $p < .05$, $R^2 = .30$. However, the interaction of negative urgency and alcohol consumption was not significant in predicting GPA. Of note, higher year in college emerged as a significant covariate ($p = .019$). Lastly, moderation findings did not reveal a significant overall model of negative urgency, with current alcohol consumption as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 2.107, $p > .05$, $R^2 = .203$. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 6* below.

Table 6. Moderation, SUPPS-P Negative Urgency and Alcohol Consumption on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.004	.003	-1.250	p = .216
GAD-7 (Anxiety)	-.0002	.003	-.070	p = .945
SACQ – Social Adjustment	.003	.007	.476	p = .636
GPA	-.0001	.001	-.171	p = .865
SACQ – Academic Adjustment	-.002	.006	-.348	p = .729

In summary, there were minimal findings when testing the interaction of the SUPPS-P negative urgency subscale and current alcohol consumption on psychosocial and academic functioning within this sample. In fact, although several overall regression models were significant, there were no interaction terms that were significant in predicting psychosocial and academic functioning difficulties among this sample.

Interaction of ADHD Specific Predictors and Binge Drinking Status. In order to assess the interaction of binge drinking status and ADHD specific predictors (*Aim 4*, Hyp 3), moderation analyses (Hayes, 2013) were conducted to determine the degree to which binge drinking status influences the relationship between ADHD specific predictors (i.e., ASRS, T.O.V.A., SUPPS-P, and BDEFS-CA) and psychosocial and academic functioning. These analyses were run using the PROCESS Macro and SPSS (Version 24, Greenville, NC), using a bootstrapping technique generating 5,000 random samples with replacement from the data set. In all of these analyses age, sex, current year in college, and history of conduct problems were entered as covariates, regardless of the significance of the model. If the moderation model was significant, it was further examined to determine if there was a significant interaction effect. The specific statistics of the interactions for each ADHD specific predictor and substance are displayed in a table under each section.

Interaction of ASRS and Binge Drinking Status. First, the interaction of the ASRS (i.e., self-reported severity of ADHD symptoms) and binge drinking status on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the ASRS in combination with binge drinking status would predict more problematic psychosocial and academic functioning in the sample (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the ASRS, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 6.806, $p <$ .001, R^2= .451. However, the interaction of the ASRS and binge drinking status was not significant in predicting depression symptoms on the PHQ-9.

Moderation analysis similarly revealed a significant overall model for the ASRS, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 4.106, p < .01, R^2= .331. However, the interaction of the ASRS and binge drinking status was not significant in predicting anxiety symptoms on the GAD-7. Moderation findings revealed a significant overall model of the ASRS, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 2.591, p <.05, R^2= .238.

However, the interaction of the ASRS and binge drinking status was not significant in predicting social adjustment difficulties on the SACQ.

In terms of academic functioning, moderation findings did not reveal a significant overall model of the ASRS, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 2.219, $p > .05$, $R^2 = .265$. Finally, moderation findings did reveal a significant overall model of the ASRS, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 2.637, $p < .05$, $R^2 = .241$. However, the interaction of the ASRS and binge drinking status was not significant in predicting academic adjustment difficulties on the SACQ. Specific results of all the moderation analysis with the ASRS can be found in *Table 7* below.

Table 7. Moderation, ASRS and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.015	.115	-.129	*p* = .898
GAD-7 (Anxiety)	-.024	.125	-.191	*p* = .849
SACQ – Social Adjustment	-.164	.291	-.563	*p* = .576
GPA	-.021	.019	-1.146	*p* = .258
SACQ – Academic Adjustment	-.407	.243	-1.671	*p* = .100

In summary, there were minimal findings when testing the interaction of the ADHD symptoms (as measured by ASRS) and binge drinking status on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes.

Interaction of T.O.V.A. Variables and Binge Drinking Status. Next, the interaction of the T.O.V.A. variables (i.e., RTV, RT, CE, and OE) and binge drinking status on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the T.O.V.A. variables in combination with binge drinking status would predict more problematic psychosocial and academic functioning in the sample. First, I report on the T.O.V.A. RTV (consistency), followed by RT (speed), CE (impulsivity), and OE (focus and vigilance). It was hypothesized that lower standard scores on the T.O.V.A. variables (i.e., less RTV, slower RT, more CE, and more OE) would interact with binge drinking status to predict more psychosocial and academic functioning difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the T.O.V.A. RTV, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.947, $p < .05$, $R^2 = .262$. However, the interaction of the T.O.V.A. RTV and binge drinking status was not significant in predicting depression symptoms on the PHQ-9. Of note, being female emerged as a significant covariate ($p = .013$). Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.557, $p > .05$, $R^2 = .158$. Moreover, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7,

58) = 1.852, $p > .05$, R^2= .183. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.36, $p > .05$, R^2= .181. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .64, $p > .05$, R^2= .072. Specific results of moderation analyses with the T.O.V.A. RTV can be found in *Table 8* below.

Table 8. Moderation, T.O.V.A. RTV and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.001	.077	-.129	*p* = .898
GAD-7 (Anxiety)	.010	.082	.118	*p* = .906
SACQ – Social Adjustment	.238	.175	1.359	*p* = .179
GPA	.006	.012	.458	*p* = .650
SACQ – Academic Adjustment	.186	.156	1.191	*p* = .239

In terms of the T.O.V.A. RT (speed), moderation findings revealed a significant overall model of the T.O.V.A. RT, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.91, $p < .05$, R^2= .26. However, the interaction of the T.O.V.A. RT and binge drinking status was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .009). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.513, p > .05, R^2= .154. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.737, p > .05, R^2= .173. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.35, p > .05, R^2= .180. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .442, p > .05, R^2= .051. Specific results of moderation analyses with the T.O.V.A. RT can be found in *Table 9* below.

Table 9. Moderation, T.O.V.A. RTV and Binge drinking status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.076	.094	-.808	*p* = .423
GAD-7 (Anxiety)	-.031	.010	-.315	*p* = .754
SACQ – Social Adjustment	.117	.214	.547	*p* = .587
GPA	.006	.015	.378	*p* = .707
SACQ – Academic Adjustment	.104	.192	.540	*p* = .591

Next, the T.O.V.A. CE (impulsivity) was examined using the PROCESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. CE, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.755, $p < .05$, $R^2 = .25$. However, the interaction of the T.O.V.A. CE and binge drinking status was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate ($p = .005$), with greater history of reported conduct problems approaching significance ($p = .062$). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.761, $p > .05$, $R^2 = .175$. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.436, $p > .05$, $R^2 = .148$. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.502, $p > .05$, $R^2 = .197$. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. CE, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .582, $p > .05$, $R^2 = .066$. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 10 below*.

Table 10. Moderation, T.O.V.A. CE and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.061	.097	-.633	$p = .529$
GAD-7 (Anxiety)	-.117	.101	-1.163	$p = .250$
SACQ – Social Adjustment	.127	.222	.570	$p = .571$
GPA	.009	.014	.648	$p = .520$
SACQ – Academic Adjustment	.218	.195	1.118	$p = .268$

Lastly, the T.O.V.A. OE (Focus and Vigilance) was examined using the PROOESS Macro. Moderation findings revealed a significant overall model of the T.O.V.A. OE, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.714, $p < .05$, R^2= .247. However, the interaction of the T.O.V.A. OE and binge drinking status was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate ($p = .006$). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.516, $p > .05$, R^2= .155. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) =1.46, $p > .05$, R^2= .15. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.362, $p > .05$, R^2= .182. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. OE, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .506, p > .05, R^2= .058. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 11* below.

Table 11. Moderation, T.O.V.A. OE and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.043	.151	-.283	*p* = .779
GAD-7 (Anxiety)	.053	.159	.331	*p* = .742
SACQ – Social Adjustment	-.044	.345	-.126	*p* = .900
GPA	.002	.022	.094	*p* = .926
SACQ – Academic Adjustment	.240	.304	.788	*p* = .434

In summary, there were minimal findings when testing the interaction of the T.O.V.A. variables and binge drinking status on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes. This remained true even after testing the dichotomized T.O.V.A. variables (i.e., within normal limits or not). This mirrored prior findings within Aim 3 in which TOVA variables were not associated with ADHD symptoms and generally not predictive of psychosocial outcomes.

Interaction of Impulsivity/Emotion Dysregulation and Binge Drinking Status. Next, the interaction of the SUPPS-P and binge drinking status on psychosocial and academic functioning was examined. Positive urgency (impulsivity) moderation findings are reported first, followed by negative urgency (emotion dysregulation) results. It was hypothesized that higher positive urgency scores would interact with binge drinking status to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of positive urgency, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 3.03, $p < .01$, R^2= .268. Upon further review, the interaction of higher positive urgency (impulsivity) and higher binge drinking status was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female emerged as a significant covariate in the model (p = .004). In addition, moderation findings did not reveal a significant overall model of positive urgency, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.663, $p > .05$, R^2= .167. Moreover, moderation findings did not reveal a significant overall model of positive urgency, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) =1.475, $p > .05$, R^2= .151. Similarly, moderation findings did not reveal a significant overall model of positive urgency, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.888, $p > .05$, R^2= .235. Lastly, moderation findings did not reveal a significant overall model of positive urgency, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .983, $p > .05$, R^2= .106. Specific results of moderation analyses with the SUPPS-P positive urgency subscale can be found in *Table 12* below.

Table 12. Moderation, SUPPS-P Positive Urgency and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.565	.573	-.986	*p* = .328
GAD-7 (Anxiety)	-.604	.606	-.996	*p* = .324
SACQ – Social Adjustment	.997	1.328	.751	*p* = .456
GPA	-.045	.086	-.517	*p* = .608
SACQ – Academic Adjustment	1.699	1.142	1.487	*p* = .143

In summary, there were minimal findings when testing the interaction of the SUPPS-P positive urgency subscale and binge drinking status on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes.

Next, moderation analyses were conducted to assess the interaction of ADHD specific variables and emotion dysregulation (negative urgency) on the SUPPS-P. It was hypothesized that higher negative urgency scores would interact with more current binge drinking status to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of negative urgency, with binge drinking status as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 5.701, $p < .001$, $R^2 = .408$. Contrary to the hypothesis, the interaction of higher negative urgency and more binge drinking status was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female emerged as significant covariate in the model ($p = .000$), with more reported conduct problems in childhood approaching significance ($p = .057$). Moreover, moderation findings revealed a significant overall model of negative urgency, with binge drinking status as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 2.79, $p < .05$, $R^2 = .252$. When examined further, the interaction of negative urgency and binge drinking status was not significant in predicting the GAD-7. Of note, being female emerged as a significant covariate ($p = .016$). Further, moderation findings revealed a significant overall model of negative urgency, with binge drinking status as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 3.063, $p < .05$, $R^2 = .27$. However, upon further review the interaction of negative urgency and binge drinking status was not significant in predicting social adjustment on the SACQ.

Similarly, moderation findings revealed a significant overall model of negative urgency, with binge drinking status as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 2.732, $p < .05$, $R^2 = .308$. However, the interaction of negative urgency and binge drinking status was not significant in predicting GPA. Of note, higher year in college emerged as a significant covariate ($p = .014$), with greater history of conduct problems approaching significance ($p = .054$). Lastly, moderation findings did not reveal a significant overall model of negative urgency, with binge drinking status as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 2.413, p > .05, R^2= .226. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 13* below.

Table 13. Moderation, SUPPS-P Negative Urgency and Binge Drinking Status on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*T*	Sig
PHQ-9 (Depression)	-.563	.506	-1.112	p = .271
GAD-7 (Anxiety)	-.234	.565	-.414	p = .681
SACQ – Social Adjustment	.783	1.210	.647	p = .520
GPA	-.028	.079	-.353	p = .726
SACQ – Academic Adjustment	.785	1.045	.751	p = .456

In summary, there were minimal findings when testing the interaction of the SUPPS-P negative urgency subscale and binge drinking status on psychosocial and academic functioning within this sample. In fact, although several overall regression models were significant, there were no interaction terms that were significant in predicting psychosocial and academic functioning difficulties among this sample.

Interaction of ADHD Specific Predictors and Current Marijuana Use

In order to assess the interaction of current marijuana use and ADHD specific predictors (*Aim 4*, Hyp 3), moderation analyses (Hayes, 2013) were conducted to determine the degree to which current marijuana use influences the relationship between ADHD specific predictors (i.e., ASRS, T.O.V.A., SUPPS-P, and BDEFS-CA) and psychosocial and academic functioning. These analyses were run using the PROCESS Macro and SPSS (Version 24, Greenville, NC), using a bootstrapping technique generating 5,000 random samples with replacement from the data set. In all of these analyses age, sex, current year in college, and history of conduct problems were entered as covariates, regardless of the significance of the model. If the moderation model was significant, it was further examined to determine if there was a significant interaction effect. The specific statistics of the interactions for each ADHD specific predictor and substance are displayed in a table under each section.

Interaction of ASRS and Current Marijuana Use. First, the interaction of the ASRS (i.e., self-reported severity of ADHD symptoms) and current marijuana use on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the ASRS in combination with more current marijuana use would predict more problematic psychosocial and academic functioning in the sample (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the ASRS, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 6.74, $p < .001$, R^2= .449. However, the interaction of the ASRS and current marijuana use was not significant in predicting depression symptoms on the PHQ-9. Moderation analysis similarly revealed a significant overall model for the ASRS, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 4.051, $p < .01$, R^2= .328. However, the interaction of the ASRS and current marijuana use was not significant in predicting anxiety symptoms on the GAD-7.

Moderation findings revealed a significant overall model of the ASRS, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, *F* (7, 58) = 1.456, p <.05, R^2= .15. However, the interaction of the ASRS and current marijuana use was not significant in predicting social adjustment difficulties on the SACQ.

In terms of academic functioning, moderation findings revealed a significant overall model of the ASRS, with current marijuana use as the moderating variable, and current GPA as the criterion variable, *F* (7, 43) = 2.633, p > .05, R^2= .30. However, the interaction of the ASRS and current marijuana use was not significant in predicting GPA. Of note, higher year in college and greater history of conduct problems emerged as significant covariates (p = .033; p = .023), respectively. Finally, moderation findings did reveal a significant overall model of the ASRS, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, *F* (7, 58) = 2.463, p < .05, R^2= .229. However, the interaction of the ASRS and current marijuana use was not significant in predicting academic adjustment difficulties on the SACQ. Specific results of all the moderation analysis with the ASRS can be found in *Table 14* below.

Table 14. Moderation, ASRS and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.022	.016	1.372	p = .175
GAD-7 (Anxiety)	.003	.017	.156	p = .877

SACQ – Social Adjustment	-.044	.042	-1.054	*p* = .296
GPA	-.005	.003	-1.755	*p* = .087
SACQ – Academic Adjustment	-.046	.034	-1.357	*p* = .180

In summary, there were minimal findings when testing the interaction of the ADHD symptoms (as measured by ASRS) and current marijuana use on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes.

Interaction of T.O.V.A. Variables and Current Marijuana Use. Next, the interaction of the T.O.V.A. variables (i.e., RTV, RT, CE, and OE) and current marijuana use on psychosocial and academic functioning was assessed. It was hypothesized that greater severity of symptoms on the T.O.V.A. variables in combination with more current marijuana use would predict more problematic psychosocial and academic functioning in the sample. First, I report on the T.O.V.A. RTV (consistency), followed by RT (speed), CE (impulsivity), and OE (focus and vigilance). It was hypothesized that lower standard scores on the T.O.V.A. variables (i.e., less RTV, slower RT, more CE, and more OE) would interact with current marijuana use to predict more psychosocial and academic functioning difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of the T.O.V.A. RTV, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 3.241, $p < .01$, R^2= .281. However, the interaction of the T.O.V.A. RTV and current marijuana use was not significant in predicting depression symptoms on the PHQ-9. Of note, being female emerged as a significant covariate (*p* = .006), with older current age approaching significance (*p* = .055). Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.849, p > .05, R^2= .182. Moreover, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = .816, p > .05, R^2= .09. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.55, p > .05, R^2= .201. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RTV, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .43, p > .05, R^2= .049. Specific results of moderation analyses with the T.O.V.A. RTV can be found in *Table 15* below.

Table 15. Moderation, T.O.V.A. RTV and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.018	.012	-1.943	*p* = .133
GAD-7 (Anxiety)	-.018	.013	-1.380	*p* = .173
SACQ – Social Adjustment	.033	.029	1.142	*p* = .258
GPA	.002	.002	1.049	*p* = .300
SACQ – Academic Adjustment	.015	.025	.621	*p* = .537

In terms of the T.O.V.A. RT (speed), moderation findings revealed a significant overall model of the T.O.V.A. RT, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.762, $p < .05$, R^2= .25. However, the interaction of the T.O.V.A. RT and current marijuana use was not significant in predicting depression symptoms on the PHQ-9. Again, being female was a significant covariate (p = .004), with older current age approaching significance (p = .053). In addition, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.497, $p > .05$, R^2= .153. Further, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = .717, $p > .05$, R^2= .08. Similarly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 1.396, $p > .05$, R^2= .185. Lastly, moderation findings did not reveal a significant overall model of the T.O.V.A. RT, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .443, $p > .05$, R^2= .051. Specific results of moderation analyses with the T.O.V.A. RT can be found in *Table 16* below.

Table 16. Moderation, T.O.V.A. RTV and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig

PHQ-9 (Depression)	-.011	.014	-.792	*p* = .431
GAD-7 (Anxiety)	-.006	.015	-.379	*p* = .706
SACQ – Social Adjustment	-.012	.033	-.350	*p* = .728
GPA	-.001	.003	-.426	*p* = .673
SACQ – Academic Adjustment	-.023	.023	-.819	*p* = .416

Interaction of Impulsivity/Emotion Dysregulation and Current Marijuana Use. Next, the interaction of the SUPPS-P and current marijuana use on psychosocial and academic functioning was examined. Positive urgency (impulsivity) moderation findings are reported first, followed by negative urgency (emotion dysregulation) results. It was hypothesized that higher positive urgency scores would interact with current marijuana use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of positive urgency, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 2.732, $p < .05$, $R^2 = .248$. Upon further review, the interaction of higher positive urgency (impulsivity) and higher current marijuana use was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female emerged as a significant covariate in the model ($p = .002$), with older current age approaching significance ($p = .066$). In addition, moderation findings did not reveal a significant overall model of positive urgency, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 1.521, $p > .05$, $R^2=$

.155. Moreover, moderation findings did not reveal a significant overall model of positive urgency, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = .625, p > .05, R^2= .070. Similarly, moderation findings did not reveal a significant overall model of positive urgency, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 2.058, p > .05, R^2= .251. Lastly, moderation findings did not reveal a significant overall model of positive urgency, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = .629, p > .05, R^2= .071. Specific results of moderation analyses with the SUPPS-P positive urgency subscale can be found in *Table 17* below.

Table 17. Moderation, SUPPS-P Positive Urgency and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	.035	.076	.455	p = .651
GAD-7 (Anxiety)	.043	.080	.539	p = .592
SACQ – Social Adjustment	-.153	.183	-.838	p = .405
GPA	-.073	.110	-.663	p = .511
SACQ – Academic Adjustment	-.052	.153	-.341	p = .734

In summary, there were minimal findings when testing the interaction of the SUPPS-P positive urgency subscale and current marijuana use on psychosocial and academic functioning within this sample. In fact, there were no interaction terms that were significant in predicting psychosocial and academic outcomes.

Next, moderation analyses were conducted to assess the interaction of current marijuana use and emotion dysregulation (negative urgency) on the SUPPS-P. It was hypothesized that higher negative urgency scores would interact with more current marijuana use to predict more psychosocial and academic difficulties (*Aim 4*, Hyp 3a and 3b).

Using the PROCESS Macro, moderation findings revealed a significant overall model of negative urgency, with current marijuana use as the moderating variable, and current depression symptoms on the PHQ-9 as the criterion variable, F (7, 58) = 5.260, $p < .001$, R^2= .388. Contrary to the hypothesis, the interaction of higher negative urgency and more current marijuana use was not significant in predicting lower depression symptoms on the PHQ-9. Of note, being female and older current age emerged as significant covariates in the model ($p = .000$; $p = .042$), respectively. Moreover, moderation findings revealed a significant overall model of negative urgency, with current marijuana use as the moderating variable, and current anxiety symptoms on the GAD-7 as the criterion variable, F (7, 58) = 2.957, $p < .05$, R^2= .263. When examined further, the interaction of negative urgency and current marijuana use was not significant in predicting the GAD-7. Again, being female emerged as a significant covariate ($p = .012$). Further, moderation findings did not reveal a significant overall model of negative urgency, with current marijuana use as the moderating variable, and social adjustment on the SACQ as the criterion variable, F (7, 58) = 1.998, $p < .05$, R^2= .194.

Similarly, moderation findings revealed a significant overall model of negative urgency, with current marijuana use as the moderating variable, and current GPA as the criterion variable, F (7, 43) = 3.407, $p < .05$, $R^2 = .357$. However, the interaction of negative urgency and current marijuana use was not significant in predicting GPA. Of note, higher year in college and greater history of conduct problems emerged as significant covariates ($p = .031$; $p = .043$), respectively. Lastly, moderation findings did not reveal a significant overall model of negative urgency, with current marijuana use as the moderating variable, and academic adjustment on the SACQ as the criterion variable, F (7, 58) = 2.413, $p < .05$, $R^2 = .226$. Specific results of moderation analyses with the T.O.V.A. CE can be found in *Table 18* below.

Table 18. Moderation, SUPPS-P Negative Urgency and Current Marijuana Use on Psychosocial and Academic Functioning

Criterion Variables	Unstandardized (B)	SE	*t*	Sig
PHQ-9 (Depression)	-.047	.069	-.685	$p = .496$
GAD-7 (Anxiety)	-.085	.075	-1.139	$p = .260$
SACQ – Social Adjustment	.218	.170	1.285	$p = .204$
GPA	-.020	.012	-1.709	$p = .095$
SACQ – Academic Adjustment	.785	1.045	.751	$p = .456$

In summary, there were minimal findings when testing the interaction of the SUPPS-P negative urgency subscale and current marijuana use on psychosocial and academic functioning within this sample. In fact, although several overall regression models were significant, there were no interaction terms that were significant in predicting psychosocial and academic functioning difficulties among this sample.