Co-occurring ADHD and Substance Abuse: Substance Use Patterns, Motives and Executive Functioning

by

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Objective: This study examined potential differences between patients in outpatient treatment for substance use disorders with ADHD and those without ADHD. Previous research has indicated that there is a higher prevalence of ADHD among patients within substance abuse treatment settings than the general population, but there is little research that describes how individuals with this comorbidity might differ. We were interested in determining potential differences between these groups in the areas of substance use history, drinking motives, and executive functioning which might influence the treatment of substance use disorders. **Method:** A total of 23 participants (mean 25.5 years) from a local substance use treatment facility qualified for the study based on the results of a prescreening to determine if they had symptoms of ADHD in childhood (WURS-25) and adulthood (ASRS). Thirteen patients met diagnostic criteria (CIDI interview) for both current and childhood symptoms of ADHD with 10 additional patients serving as a comparison group reporting neither childhood nor current symptoms of ADHD. Participants completed assessments regarding their substance use history, drinking motives and a measure of executive functioning (BDEFS); the comorbid ADHD and substance use group additionally completed several qualitative questions regarding how ADHD has influenced their efforts at treatment and recovery. **Results:** Participants with comorbid ADHD and substance use disorders were clearly a distinct subgroup; they had a different profile

for substance use history, including using more overall types of substances as well as cocaine and prescription stimulants; were more likely than those with substance use alone to initiate alcohol, nicotine, and marijuana at an earlier age; and had used alcohol for a longer period of time. Motives for drinking did not differ although the ADHD group had somewhat more conduct problems in childhood. Both groups reported significant difficulties with executive functioning, but those with comorbid ADHD and substance use disorders reported significantly more problems with executive functioning in daily life than those without ADHD. Although the number of past treatment episodes did not differ, qualitative responses suggested ways ADHD might impact treatment. **Conclusion:** More research is needed to better characterize comorbid ADHD and substance use disorder and determine the implications such differences might have on treatment and recovery efforts.

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CHAPTER 1: LITERATURE REVIEW

Comorbid mental health conditions accompanying substance use disorders negatively influence risk, onset, course, severity, and treatment of the substance abuse. One of the most common comorbidities associated with substance use disorders is Attention Deficit Hyperactivity Disorder (ADHD), a disorder marked by deficits in attention and executive functioning. A recent meta-analysis reviewed 29 studies that looked at the prevalence rates of ADHD within substance abuse populations and found that prevalence of ADHD was 21% in adults and 25% among adolescent populations (van Emmerik-van Oortmerssen et al., 2012). This is highly significant because the prevalence rate of ADHD within the general population is typically only 3-5% (Barkley, Murphy, & Fischer, 2008). However, for many of these patients, ADHD may go unrecognized (Kessler et al., 2006); although they may meet the criteria for a diagnosis of ADHD, they may not have been previously diagnosed before entering substance abuse treatment.

Having ADHD may negatively influence the success of a patient's substance abuse treatment, as people with ADHD may struggle with poorer treatment adherence, difficulty with achieving the goals set in treatment, and higher rates of relapse upon leaving substance abuse treatment due to attentional difficulties and poor executive functioning associated with the disorder (Arias et al, 2008; Carroll & Rounseville, 1993; Ohlemeier et al., 2008; & Wise, Cuffe, & Fischer, 2001). For example, one study that looked at patients entering a hospital-based clinic for methadone treatment found that 19% of the sample had self-reported symptoms of ADHD that interfered with their life functioning (Kolpe & Carlson, 2007). These patients had more difficulty maintaining abstinence 9-months later than their peers that did not struggle with these symptoms (Kolpe & Carlson, 2007). This pattern could be due to impulsivity, missing

appointments due to poor planning, or other factors associated with their ADHD symptoms. It is possible that these outcomes could be compounded when ADHD is undiagnosed and untreated.

The identification of these patients and the eventual development of evidence-based psychosocial treatments for ADHD within substance use populations could greatly improve the course and success of their treatment. This paper will first review relevant background literature on substance use disorders, ADHD and their co-occurrence, with a particular focus on reasons for their association and the likely impact of ADHD on substance use pattern and recovery. Second, a proposed thesis project is described which examines the association of co-occurring ADHD in substance abuse patients on both substance abuse variables and reported problems in executive functioning.

Substance Use Disorders

According to data from the National Survey on Drug Use and Health, an estimated 20.6 million persons (8.0 percent of the population aged 12 or older) were classified with substance abuse or dependence in the past year based on the DSM-IV criteria (SAMHSA, 2012). Of these, 2.6 million were classified with abuse or dependence for alcohol as well as illicit drugs, 3.9 million had abuse or dependence of illicit drugs but not alcohol, and 14.1 million had abuse or dependence on alcohol but not illicit drugs (SAMHSA, 2012). It is estimated that 22.5 million Americans aged 12 or over—8.7% of that age group—reported using an illicit drug within a month of being interviewed in 2011. These included but were not limited to marijuana, cocaine, heroin, hallucinogens, inhalants, and non-medically used prescription drugs. The National Institute on Drug Abuse (2005) reports that substance abuse is a serious public health, social, and economic problem. The National Institute on Alcohol Abuse and Alcoholism reports that the annual cost related to the misuse of alcohol to be over $180 billion, and combination of alcohol,

tobacco, and illicit drug use to be over $450 billion annually (National Institute on Drug Abuse, 2005).

The previous Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) (American Psychiatric Association, 2000) divided substance related disorders into two categories: substance use disorders and substance-induced disorders. For the purpose of this research, substance use disorders including substance abuse and substance dependence were reviewed. The hallmark of substance dependence is a maladaptive pattern of substance use that continues for at least 12 months, with three or more cognitive, behavioral, and/or psychological symptoms (American Psychiatric Association, 2000). These symptoms include tolerance, withdrawal, and several indicators of compulsive use reflective of dependence. *Tolerance* means that increased amounts of the substance are needed to achieve the same effect, and *withdrawal* refers to the physiological substance-specific syndrome that occurs when one refrains from use of the substance after a long period of heavy use (American Psychiatric Association, 2000).The criteria for compulsive use can be met in several ways including failure to meet important social or occupational obligations, time spent in the activities necessary to obtain the substance, persistent or unsuccessful efforts to cut down or control substance use, and taking the substance in larger amounts or over a longer period than was intended.

In order for an individual to meet the criteria for substance abuse, there must be evidence of persistent problems(s) in at least one of the following areas; vocational or school, problems with the legal system, social and/or interpersonal problems, and physically hazardous situations (American Psychiatric Association, 2000).

The historic distinction between substance abuse and substance dependence suggests that substance abuse is a less severe disorder or a precursor to substance dependence. However,

according to the literature, the distinction between the two has been increasingly questioned on both psychometric and conceptual grounds (Verges, Steinley, Trull & Sher, 2010). Some have suggested that these are not in fact distinct categories but a unidimensional continuum of substance-problem severity (Hasin, Hatzenbuehler, Keyes, & Ogburn, 2006; Martin, Chung, & Langerbucher, 2008). In fact, the most recent version of the Diagnostic and Statistical Manual (DSM-5) has done exactly that. They have combined substance abuse and substance dependence criteria into one category called "substance use disorder" with the understanding that diagnosis is to be made if individuals continue to use the substance despite substance-related problems (American Psychiatric Association, 2013). Severity specifiers are based on the number of specific substance symptom criteria that are endorsed, with mild indicating two or three symptoms, to severe indicating six or more of 11 possible symptom criteria (American Psychiatric Association, 2013).

Substance abuse is properly thought of as a developmental disorder in that onset typically begins in adolescence with the prevalence of alcohol and other drug use and associated problems peaking in young adulthood (Hingson, Heeren, & Winter, 2006; Rohde, Lewinsohn, Kahler, Seeley, & Brown, 2001). For instance, alcohol use is most likely to become problematic in late adolescence and early to mid-twenties, and most individuals who develop alcohol-related disorders will do so by their late 30's (American Psychiatric Association, 2013). Research suggests that those who start drinking before age 14 are more likely to develop alcohol dependence when compared to those that start drinking at age 21 (Hingson et al., 2006). In addition, adolescents who have problematic use of alcohol are more likely to develop alcohol dependence and other substance use disorders, compared to those without alcohol use disorders in adolescence, suggesting that earlier problematic use does not necessarily resolve without

intervention (Rohde et al., 2001). For these reasons, early identification and developing effective interventions in young adults at risk are particularly important. One such known risk factor is ADHD especially when associated with conduct difficulties.

Attention Deficit Hyperactivity Disorder

ADHD has been defined as a common, highly heritable, neurobehavioral disorder, beginning in childhood but often persisting into adulthood, which is associated with significant impairment in psychosocial functioning (Biederman, 2005). This definition provides a useful framework for discussing the diagnosis of ADHD, as it includes some of the components important to the diagnosis such as age of onset, and impairment in life functioning. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), "The essential feature of Attention-Deficit/Hyperactivity Disorder is a persistent pattern of inattention and/ or hyperactivity-impulsivity that interferes with functioning or development" (2013, p. 61). Individuals diagnosed with ADHD are thought to fall into one of three presentation types based on the prevalence of their symptoms: predominately inattentive, predominately hyperactive-impulsive, or combined inattentive/ hyperactive-impulsive. However useful these presentation types may be for clinical use, research suggests that they do not demonstrate stability over time, and thus classification based on these presentation types as distinct forms of the disorder may not be justified through the lifespan (Willcutt et al., 2012).

ADHD is a disorder that was historically associated with childhood (Barkley et al., 2008). However, ADHD has been shown to be relatively persistent across the lifespan, and adult ADHD has been generating more attention and thus more controversy in recent years (Barkley et al., 2008; Spencer, Biederman, Wilens & Farone, 1994). While ADHD in children was first recognized in the early 1900s, understanding about the persistence of this disorder into adulthood

was not recognized until the 1970's (Wood et al., 1976). In fact, adult ADHD may actually be *under-diagnosed* because it has only recently been recognized by the professional community, particularly for those with the inattentive subtype (Wells, 2005). Compared with children, symptoms in adults are less disruptive, as they tend to reflect the changes in their activities and responsibilities (Adler & Cohen, 2004). Thus, diagnosis of ADHD in adults involves careful interviewing about the lifelong history of inattention, restlessness, impulsivity, and disorganization—rather than hyperactivity which is easier to identify (Faraone, Spencer, Montano, & Biederman, 2004).

According to one prominent theory by Barkley (1997), those with ADHD may have poor control over executive functioning which may be linked to deficits in the frontal-lobe regions of their brain. The symptoms of ADHD can present in many different ways and symptoms vary among diagnosed individuals: poor organizational skills, inability to attend to details at work or school, excessive procrastination, or "hyper-focus" in which an individual focuses on relatively unimportant details or tasks to the exclusion of everything else (Elliott, 2002). Adults most frequently report the symptoms of ADHD as "feeling scattered and being chronically late for appointments, anxious, irritable, and overwhelmed with the tasks of daily living" (Elliott, 2002, p. 737).

According to the DSM-IV, the prevalence of school aged-children with ADHD ranges from 4%-12%, but it is suggested that these data may vary based on the population and sampling method (American Psychiatric Association, 2000). Additionally, the DSM-IV does not suggest a prevalence range for adolescents or adults because data are limited on the persisting prevalence of ADHD. One study suggests the rates for prevalence into adulthood is approximately 50%-70%, based on data from self-reports and parent reports of childhood functioning (Barkley,

Fischer, Smallish, & Fletcher, 2002). This indicates that as many as one-third to one-half of all children with ADHD appear to outgrow it, and no longer meet the diagnostic criteria as young adults (Barkley et al., 2002). ADHD prevalence into adulthood is thought to be between 1% and 6% of the general population (Wender, Wolf, & Wasserstein, 2001). One epidemiological study rated the prevalence of adult ADHD at 4.4% (Kessler et al., 2006). While the specific statistics are not entirely clear, it does appear that for half of those diagnosed in childhood, ADHD will persist into adolescence and adulthood. The prevalence of ADHD in adulthood has been difficult to establish due to controversies surrounding diagnostic criteria, as well as a relative shortage of longitudinal studies that follow children with ADHD into adulthood (Barkley et al., 2008). Analysis based on longitudinal studies following children with ADHD into adulthood suggest a prevalence rate between 3.3% and 5.3% although "actual studies of large general population samples have more recently placed the figure at nearly 5% of adults, representing more than 11 million adults in the United States alone" (Barkley et al., 2008, pp. 24-25). Differences in percentages of adults with ADHD that has persisted since childhood may be reflective of a lack of operational definition, rather than the actual course of ADHD (McGough & Barkley, 2004).

Conduct Difficulties

In the previous iteration of the DSM (IV-TR), conduct disorder (CD), oppositional defiant disorder (ODD), and attention-deficit hyperactivity disorder (ADHD) are presented under the grouping of Attention-Deficit and Disruptive Behavior Disorders (American Psychiatric Association, 2000). ODD is characterized as “a recurrent pattern of negativistic, defiant, disobedient, and hostile behavior directed at authority figures that persists for at least six months,” and frequently manifests in children as defiance of authority, excessive anger and resentment, and may include bullying, frequent loss of temper and blaming others (American

Psychiatric Association, 2000, p. 100). In order for ODD to be diagnosed, 4 of the 8 symptoms must be endorsed, and must cause significant functional problems at home, school, or in social relationships (American Psychiatric Association, 2000). If left untreated, as many as 52% of children with ODD will continue to meet the diagnosis for ODD three years after initial diagnosis, and half of that group will later meet the criteria for conduct disorder. Therefore ODD may be considered an antecedent to CD (Lahey, Loeber, Quay, Frick, & Grimm, 1992). There is a hierarchical relationship between ODD and CD, which indicates that although they fall along the same continuum, CD is a more severe behavioral disorder than ODD, and if CD is diagnosed, ODD is not (American Psychiatric Association, 2000).

The essential feature of CD is "a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated (American Psychiatric Association, 2000, p. 93)" CD is a condition that describes an individual with aggressive, antisocial, and criminal tendencies. When making a diagnosis of CD, multiple factors must be considered including the symptoms, timing of onset, and the function of the symptoms (Olsson, 2009). It is also important to consider the complicated interplay of biological and environmental factors including cognitive, neurological, intrapersonal factors, social influences, and context, as these etiological mechanisms serve as important considerations in which evidenced-based treatments are utilized in treating the disorder (Murrihy, Kidman, & Ollendick, 2010).

There are two developmental courses of CD: "childhood onset" type when conduct disorder symptoms occur before age 10, and "adolescent-onset" type when symptoms occur after the age of 10. Diagnosis involves meeting at least three of the criteria over the past twelve months, with at least one occurrence within the last six months, and criteria include aggression to

people and animals, destruction of property, deceitfulness or theft, or serious violation of the rules, which causes significant impairment in multiple domains (American Psychiatric Association, 2000). Just as CD in childhood is often preceded by a diagnosis of ODD, CD is often considered a precursor to antisocial personality disorder. Not all of those diagnosed with CD in childhood or adolescence will receive a diagnosis of antisocial personality disorder as an adult; only 25-40% of youth with CD will develop antisocial personality disorder (Loeber, Keenan, Lahey, Green, & Thomas, 1993).

In the presence of substance use disorders, it can be difficult to diagnose conduct disorder, as it is challenging to determine which symptoms are related to the influence of alcohol or other drugs, and which are truly conduct related. Substance use disorders can either directly or indirectly cause behaviors associated with conduct disorder. This may be due to the cyclical relationship between substance use and conduct problems—aggressive behaviors increase use of substances, which in turn lead to more aggressive behaviors (White, Loeber, Stouthamer-Loeber, & Farrington, 1999). Therefore, it is not always easy to separate out conduct disorder in the presence of substance abuse, particularly within a substance use disorders treatment setting. One study showed that on initial screening, 95% of the adolescents being treated for substance abuse displayed a history of conduct disorder type behavior, but after more stringent assessment was conducted (e.g., exclusion of behaviors directly or indirectly related to alcohol or drug involvement) only 47% met criteria for conduct disorder (Brown, Gleghorn, Schuckit, Myers, & Mott, 1996). This suggests that approximately half of those who initially meet criteria for conduct disorder may display these behaviors as a result of their alcohol and other drug involvement, rather than having an independent conduct disorder (Brown et al., 1996). The difficulty of teasing out the effects of substance use disorders and conduct disorder, and its

association with attention difficulties makes the need to assess for childhood conduct problems particularly important when examining ADHD in a substance use disorders population.

Comorbidities

Although high comorbidity of substance abuse and mental health disorders reflects a small portion of the general population, these individuals account for a majority of individuals with severe impairment (Chan, Dennis, & Funk, 2008; Kessler et al., 2006). These compounding disorders can have significant negative implications in terms of the onset, course, severity, and treatment of substance use disorders (Arias et al., 2008). Both internalizing disorders (such as depression and anxiety) and externalizing disorders (such as CD and ADHD) are frequently comorbid with substance use disorders in adolescents, and may represent different pathways to the development of substance use disorders (Arias et al., 2008; Chan et al., 2008). The most common co-occurring problems include CD (74.2%), ADHD (63.6%), depression (54.7%), and traumatic stress (50.6%) (Chan et al., 2008).

When looking at a large sample of adolescents and adults seeking treatment for substance abuse, two thirds of all patients had a co-occurring disorder in the year prior to treatment, and in particular, young adults were found to be most vulnerable to these co-occurring disorders (Chan et al., 2008). Thus, it is clear that in addition to addressing substance use disorders in treatment, particular attention to specific co-occuring problems that may influence treatment outcome also needs to be considered.

Comorbid ADHD and Substance Use Disorders

One of the most common comorbidities associated with the development of substance use disorders is ADHD although research to date has not pinpointed why this increased risk for those with ADHD to develop substance use disorders occurs (Charach, Yeung, Climans, & Erin, 2011;

Molina & Pelham, 2003; Wilens, 2004b; Wilens et al., 2011). Based on the literature from both longitudinal prospective studies following children with ADHD into adulthood, and retrospective studies of those in treatment for substance use disorders, it is clear that the presence of comorbid substance use disorders and ADHD is not only higher than expected, but may have long term implications in terms of the development, course, and treatment of substance use disorders (Arias et al., 2008; Faraone, Wilens, Petty, Antshel, Spencer, & Biederman, 2007; Wilens, 2004b). Based on his review of the literature, Wilens concluded that "ADHD is associated with different characteristics of substance abuse: substance abuse transitions more rapidly to dependence, and lasts longer in adults with ADHD than those without ADHD" (Wilens, 2004a, p. 38). Studies looking at ADHD and substance use variables will be reviewed further below.

Prospective longitudinal studies. Longitudinal studies have demonstrated that children with ADHD are at higher risk for developing substance abuse, particularly alcohol and nicotine use disorders (Charach et al., 2011; Mirza & Bukstein, 2011). A meta-analysis of 27 such longitudinal studies that followed children prospectively into adolescence and adulthood found that children diagnosed with ADHD are more likely to have ever used nicotine or other substances than their non-ADHD counterparts, and were more likely to develop substance use disorder for nicotine, alcohol, marijuana, cocaine or other drugs (Lee, Humphreys, Flory, Liu, & Glass, 2011). Across reviewed studies, these authors argued that early ADHD strongly predicts substance use disorders in adolescence and adulthood, regardless of the specific demographic and methodological factors across studies. They found that children with ADHD were 1.5 times more likely to develop substance use disorders across a range of substances (Lee et al., 2011).

One of these studies examined the impact of specific ADHD symptoms and severity on use of drugs in 143 treatment-seeking adolescents diagnosed with ADHD, compared with 100

demographically similar adolescents (Molina & Pelham, 2003). Results showed that subjects 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 (Molina & Pelham, 2003). Although no differences in use were observed for alcohol, those with ADHD reported significantly more alcohol-related problems, indicating that childhood ADHD may be associated with greater impairment from drinking (Molina & Pelham, 2003). They also found that type of ADHD symptoms was important when predicting future behaviors. For instance, childhood symptoms of hyperactivity/impulsivity was associated with earlier initiation of cigarettes and illicit drug use, while the severity of childhood inattention symptoms predicted earlier first use of illicit drugs and prospectively predicted substance use outcomes, even after statistically controlling for ODD/CD symptoms (Molina & Pelham, 2003).

Treatment status of adolescents with ADHD may also influence the likelihood of developing future substance use disorders (Biederman, Wilens, Mick, Spencer, & Faraone, 1999). Biederman and his colleagues evaluated adolescent males diagnosed with ADHD over a 4-year period (1999). They found that the participants who did not receive treatment (in this case ADHD medication) had a significantly higher risk of developing a substance use disorder compared to a either a control group without ADHD, or those diagnosed with ADHD who had received pharmacotherapy treatment (Biederman et al., 1999).

Retrospective studies. In addition, retrospective studies of adults in substance abuse treatment for alcohol abuse also show a much higher prevalence of childhood onset and persistent ADHD (between 35% to 71%) than one would expect based on a prevalence rate of 3-5% within the general population (Wilens, 2004b). A recent meta-analysis reviewed prevalence

studies of ADHD within substance abuse populations, and found that of the 29 studies included, the pooled prevalence of ADHD was 23.1% in adults and adolescents irrespective of other variables such as age, gender, ethnicity, or setting (van Emmerik-van Oortmerssen et al., 2012). They also performed analysis on adults and adolescents separately, and found that the overall prevalence of ADHD in adult substance use disorder populations was 21.0% compared to 25.3% of adolescents (van Emmerik-van Oortmerssen et al., 2012), which is consistent with the research that symptoms of ADHD may be less severe in some adults (Barkley et al., 2006).

For example, McAweeney, Rogers, Huddleston, Moore and Gentile (2010) systematically examined the prevalence of ADHD in 87 adult patients in treatment for substance use disorders, examining both prior diagnoses and conducting current evaluations. They sought to determine if the rate of ADHD was significantly higher when assessed by a psychologist compared to the rate ascertained from just previous diagnosis. Based on a review of client records, they determined that of 97 participants, only one had a previous clinical diagnosis of ADHD. However, these investigators found an additional 35 participants who met the full diagnostic criteria for ADHD after a thorough psychological assessment, including having symptoms since childhood (McAweeney et al., 2010).

Conduct Disorder and ADHD

While it is clear that there is an increased incidence of ADHD among both adolescent and adult populations with substance use disorders, the specific role that ADHD plays in the development of substance use disorders is less clear—particularly when considering the frequent comorbidity of conduct disorder with ADHD. The literature is mixed regarding the specific independent contributions of ADHD and CD to substance use disorders—some report that the effects of ADHD are not as significant when controlling for CD, others suggest that CD might be

a mediating factor between ADHD and SUD, while others propose that ADHD is an independent predictor of substance use disorders.

Some researchers suggest that the link between substance use disorders and ADHD is overstated, and that this relationship is due to other factors, including the presence of CD (Lynskey & Hall, 2001). Unfortunately, these authors conducted a global substance abuse assessment, and did not differentiate the potential effects of ADHD by substance (Lynskey & Hall, 2001), while recent research has demonstrated that *specific type* of substance used may be influenced by ADHD symptoms (Molina & Pelham, 2003). Some studies suggest that the effects of ADHD are not significant or as large when controlling for comorbid CD (Flory & Lynam, 2003; Torok, Darke, & Kaye, 2012), suggesting that CD, rather than ADHD symptoms, contributes to the development of substance use disorders. The Torok et al. study examined individuals who abused psychostimulants on at least a weekly basis for the past six months (2012). Their 269 participants were screened for ADHD using the Adult Self Report Inventory. Although they found that CD was a significant independent predictor of drug use behavior and strongly associated with risky substance use behaviors, self-reported ADHD symptoms were also found to independently predict substance use behaviors, although more weakly than CD (Torok et al., 2012). The Flory and Lynam study indicated that participants with both ADHD and CD had greater risks for substance abuse than those with either disorder alone, which suggests that there is an additive relationship between CD and ADHD, and that the effects of both disorders on substance abuse are greater than either one alone (2003).

Others researchers have suggested that the relationship between substance use disorders and ADHD is mediated by CD, and factors such as a deviant peer group, rather than ADHD symptoms, influence the development of substance use disorders (Looby, 2008). This may be

possible, as conduct disorders have been shown to have a reciprocal relationship with substance use disorders, each exacerbating the expression of the other (Mirza & Bukstein, 2011). Conduct disorders may therefore be a mediating variable between ADHD and substance use disorders, and when the two are comorbid, they create a combined risk for developing substance use disorders that is greater than either disorder alone (Mirza & Bukstein, 2011).

However, others investigators suggest that even when CD is statistically controlled for, there is a unique contribution of ADHD that predicts the onset of substance use problems (Elkins, McGue, & Iacono, 2007; Wilens et al., 2011). Among adolescents, the degree of risk for developing substance use disorders appears to be related to specific drugs of abuse and particular ADHD symptoms (Looby, 2008). Moreover, factors often associated with ADHD, and not conduct disorder, have been linked to the increased risk for substance use disorders in youth diagnosed with ADHD including: academic dysfunction, cognitive deficits, and neurobehavioral disinhibition (Wilens, 2004b).

Clearly, these various perspectives highlight the difficulties associated with disentangling the complex comorbid diagnoses associated with the development of substance use disorders, and demonstrates the need to control for conduct problems to determine the unique contribution of ADHD on substance use disorders. Regardless of our understanding their unique contributions, it is clear that the combined effect of both ADHD and CD can be detrimental. Patients with the additional co-occurring diagnosis of conduct disorder along with ADHD have been found to have the poorest outcomes in terms of their long-term course of substance abuse (Wilens et al., 2011). The development of more efficacious treatments for those with both substance abuse and these co-occuring disorders may depend on better understanding how each

contributes to substance abuse pattern and motives along with their impact on recovery. Determining associated differences will allow the development of targeted treatment plans.

What Distinguishes Substance Abuse Patients with ADHD

Although the specific pathways between the development of ADHD and substance use disorders are unclear, it appears that ADHD is significantly associated with substance use disorders and often goes unrecognized. This increased risk for children and adolescents with ADHD to develop substance abuse is significant for both research and clinical practice due to the implications it has for earlier identification, treatment, and recovery of individuals with both disorders. The opportunity for more targeted treatment approaches at earlier stages in their expression of symptoms could lead to better long-term outcomes for co-occurring mental health and substance abuse disorders (Wilens, 2004a). The identification and treatment of unrecognized ADHD within a substance use disorder population could greatly impact the course and success of treatment.

Prior research has focused on the prevalence of co-occurring ADHD and substance abuse and suggested a negative impact on treatment but has not examined how such individuals differ from other young adults with substance abuse. Research is needed to determine the effects of ADHD with and without conduct problems, and to determine how young adults with substance abuse problems and ADHD differ in terms of factors that could influence substance abuse treatment. Possible factors that may help clinicians understand the impact of co-occurring ADHD and substance use are substance abuse patterns, motives for use, as well as executive functioning.

Substance Abuse Patterns

In terms of substance abuse, the literature has not systematically examined the differences between those with substance use disorders and those with co-occurring ADHD. However a number of studies primarily examining prevalence of ADHD have reported such differences. For example, Ohlemeier and his colleagues (2008) looked at ADHD retrospectively in adult patients in inpatient substance abuse treatment (N=152) with either alcohol dependence (n=91) or multiple substance addiction (n=61). In the alcohol dependent patients, both the age when first commencing alcohol use and the age at which they exceeded a critical level of alcohol use were significantly younger in the group with ADHD than those without (Ohlemeier et al.). This was also true for the patients addicted to multiple substances—a significantly lower age of first consumption was found for each of the drugs assessed in those with ADHD compared to those without ADHD including: marijuana, amphetamines, cocaine, and heroin (Ohlemeier et al.). This suggests that childhood ADHD predisposes some adolescents to develop substance abuse problems earlier, and given that earlier age of onset is a predictor of long term severity of substance use, ADHD's effect on age of onset may negatively impact both the progression and course of substance use disorders (Arias et al, 2008; Ohlemeier et al., 2008). In addition, ADHD has been associated with higher relapse rates after successful substance abuse treatment, which suggests that the necessity of managing both ADHD in addition to their substance use has a negative impact on the treatment and possibly the recovery process of those with comorbid substance use disorders and ADHD (Carroll & Rounsaville, 1993).

It is hard to interpret this literature because different investigators have examined different substance abuse populations (i.e., drug of choice such as alcohol, stimulants, opiates, etc.), settings (e.g., inpatient vs. outpatient), and different substance use variables. Potential

variables of interest are: age of onset of alcohol use, age of onset of alcohol problems, duration of alcohol problems, lifetime number/types of other illicit drugs used (particularly abuse of stimulants), smoker status and years smoked, number of unsuccessful attempts to quit drinking, age of first treatment for substance use disorders, number of past substance abuse treatments excluding detox, longest period of active treatment, and longest period of abstinence. There certainly could be pre-existing difference between the groups or third variables such as age or presence of conduct problems that account for some of these differences. Moreover, some results or findings related to how the substance use patterns or those with ADHD differ have been inconsistent. Nevertheless, an attempt was made to review the major studies found examining substance abuse differences which are listed in Table 1. The substance abuse patterns examined can be broadly broken into several categories: course of use and development of problems, as well as age at treatment and treatment attempts.

The literature appears to suggests that those with ADHD have an earlier age of first substance use (Arias et al., 2008), and studies looking at participants' initial use of alcohol (Schubiner et al., 2000) and cocaine use (Carroll & Roundsaville, 1993), indicated that participants with comorbid ADHD tended to start using substances at an earlier age than those without comorbid ADHD. As discussed previously, this is important, because those who start use of and experimentation with substances earlier tend to also develop problematic use earlier than their peers (Hingson et al., 2006; Rohde et al., 2001). The literature was generally consistent, although the results were not always statistically significant. For example, in Levin and colleagues study of cocaine abusers with ADHD they tended to have earlier onset of initial and regular cocaine use but this trend was not statistically significant (Levin, Evans, & Kleber, 1998). Other studies found significant results in terms of age of development of substance use

disorders including: multiple substance dependence diagnosis (Arias et al., 2008), more severe and earlier cocaine abuse (Carroll & Roundsaville, 1993) alcohol tolerance/loss of control of drinking (Johann, Bobbe, Putzhammer, & Wodarz, 2003) or alcohol dependence (Schubiner et al., 2000). Again, even within studies, results were not necessarily significant for other drugs (Schubiner et al., 2000), and it is difficult to draw firm conclusions about the earlier age of onset of use or problematic use, although it appears that those with comorbid ADHD tend to use and develop problems with substances earlier than their peers without ADHD.

Related to the severity of problems and treatment, the literature suggests that those with ADHD are more likely to seek treatment earlier for substance use disorders, which may indicate more severe problems at an earlier age. For instance, in a study of cocaine abusers in treatment, those with childhood ADHD were younger at presentation for treatment and reported more severe substance use, as well as more previous treatment/higher rates of relapse after successful treatment (Carroll & Roundsaville, 1993). Other studies of people with alcohol problems who were in treatment, found similar results—those with comorbid ADHD were younger at age of first treatment for alcohol dependence, and had both a significantly higher daily alcohol intake, and intake per month (Johann et al., 2003), and women with ADHD had a higher number of treatments for alcohol abuse (Schubiner et al., 2000). In a study that examined the length of stay in a residential treatment center, the mean number of days in treatment was lower in ADHD group, but this result was not statistically significant (McAweeney et al., 2010). In a study examining those in treatment for methadone, researchers for that those who self-reported attentional difficulties were less likely to be successful in treatment, defined as abstinence nine months after admission to treatment, than their peers that did not report difficulties with attention (Kolpe & Carlson, 2007). Based on the literature, it is not clear if those with comorbid ADHD

have more treatment attempts and are less successful than their peers in treatment, but it is clear that there is need for further examination of these variables, particularly as they may be related to factors that could influence treatment. It is important to explore the specific factors that make those with ADHD in substance abuse treatment different than those with substance use disorders alone, in order to improve their long-term outcomes for both treatment and recovery.

Table 1. Substance Abuse Patterns in ADHD Comorbid Substance Abuse Patients

Reference Source	**Study Population, Design, and measures used**	**Substance Abuse variables examined**	**Findings**	**Comments**
Arias et al., 2008	N= 1,761 adults (not in treatment) with lifetime diagnosis of cocaine and/or opioid dependence. Retrospectively compared 92 participant with LIFETIME ADHD (5.22%) with rest of the sample. Semi-structured assessment for drug dependence and alcoholism (SSADDA)	1. Prevalence of dependence diagnosis, 2. Age of first use, 3. Age at first dependence 4. Hospitalization for substance use and psychiatric disorders	ADHD group had earlier age of first substance use, more substance dependent diagnosis, even when controlled for CD and BPD.	Only looked at when dependent on a drug, not abused
Carroll & Roundsaville, 1993	N= 298 cocaine abusers, half from inpatient and half outpatient treatment settings. Retrospectively compared 35% of sample that met DSM-III criteria for childhood ADHD with rest of the sample. Addiction Severity Index, ADHD= DSM-III criteria SUD= CIDI substance module, ADHD= Wender and by DSM-IV criteria	1. Substance use severity and patterns, 2. level of functioning, and 3. SUD related problems	Cocaine abusers with childhood ADHD were younger at presentation for treatment and reported more severe substance use, earlier onset of cocaine abuse, more frequent and intense cocaine use, intranasal rather than freebase or intravenous use of cocaine, higher rates of alcoholism, and more previous treatment/higher rates of relapse after successful treatment.	Not current ADHD symptoms, only lifetime or childhood

Johann et al., 2003	N= 314 Alcoholics in inpatient treatment. 21.3% had lifetime ADHD with ongoing symptoms into adulthood. Compared 314 alcoholic to 222 unrelated healthy subjects	Differences in use and severity of SUD	Alcoholics with ADHD had a younger age at onset of tolerance/ loss of control of drinking, compared to those without ADHD. They were also younger at age of first treatment for alcohol dependence. They had a significantly higher daily alcohol intake, intake per month. Alcoholics with ADHD had more lifetime court proceedings against them. There was no significant differences in social complications such as unemployment or divorce.	They did not find any differences in terms of 5-HTT genotype or 5-HT2c allele between those with comorbid ADHD and those without, which suggested to these investigators that the comorbidity forms a unique phenotype, based on interactions with the environment, which leads to more severe substance use disorders.
Kolpe & Carlson, 2007	N=687 patients in a methadone maintenance program, 19% of the sample reported attention symptoms that interfere with functioning. Retrospectively compared those with symptoms of ADHD to those without. ADHD= Attention Deficit Disorder Screen	Success of treatment 9 months after admission	Those who reported ADHD were less likely to be highly successful in treatment, defined as abstinence, than those who did not report ADHD symptoms	
Levin et al., 1998	N= 281 cocaine abusers seeking outpatient treatment, 12% of the sample met criteria for childhood ADHD 79% of those had current symptoms; required "current" cocaine use as defined within the past 3 weeks but not the past 4 days. Compared those with CURRENT ADHD to those without ADHD. SCID for DSM-IV, SCID-like module (KID-SCID)=ADHD; Pattern of Drug Use Questionnaire	Age of first use, age of regular use, amount spent prior to treatment ($), # of days used prior to treatment, period of longest abstinence, prevalence of other psychiatric disorders, current abuse/dependence on alcohol, marijuana, or nicotine	Those with ADHD had more substance use disorders, including marijuana dependence. Non- significant trend for those with ADHD or subthreshold ADHD symptoms to have earlier onset of initial and regular cocaine use, to spend more money on cocaine in the month prior to treatment	They also asked the patients if they felt that drug use improved, worsened, or had no impact on their ADHD symptoms They found that 11% of the sample reported symptoms of ADHD developed after regular drug use, potentially suggesting another diagnostic category of those with secondary ADHD symptoms
Ohlemeier et al., 2008	N= 91 patients within alcohol dependence inpatient treatment. Retrospectively compared those with ADHD to those without ADHD. ADHD= Wender, DSM-IV checklist, CAARS	Use of alcohol and use of nicotine, age of first use of alcohol, age when alcohol exceeded critical level	Patients with ADHD showed "average to high" nicotine dependence, Alcohol addiction started at an earlier age in the ADHD patients, but	

			this result was not statistically significant	
Schubiner, et al., 2000	N=201 patients in treatment. Retrospectively compared those with ADHD + CD, ADHD only, and CD only to a group without ADHD or CD. SCID for DSM-IV, DSM-IV criteria for ADHD; ASI	Age of onset of abuse or dependence for specific drugs, number of treatments for alcohol abuse/dependence, number of treatments for drug abuse/dependence,	Those with ADHD were more likely to have motor vehicle accidents, and women with ADHD had a higher number of treatments for alcohol abuse. No statistical significance in psychiatric comorbidities. Those with ADHD tended towards earlier age of alcohol dependence, but age of onset of all other drugs was not significant.	
McAweeney, et al., 2010	N= 87 patients in residential treatment. Retrospectively compared those with ADHD to those without. Stage 1: Reviewed records for previous ADHD diagnosis, Stage 2: ADHD=ASRS and DSM-IV criteria follow up	Length of stay in a residential treatment center	The mean number of days in treatment was lower in ADHD group, but this was not statistically significant	

Motives for Use

It is important to understand patients' motivations to use alcohol and other drugs in order to best tailor intervention and treatment approaches to most efficiently address their difficulties. Research suggests that cognitive processes such as expectancies and motives are central to alcohol and other drug use (Cooper, 1994; Cox & Klinger, 1988; Doyle, Donovan & Simpson, 2011; Kuntsche, Knibbe, Gmel, & Engels, 2005), and understanding and taking into account specific motivations for use of substance could beneficially influence treatment (Doyle et al., 2011).

General population studies of motives reveal that there are generally four types of motives for substance use including coping, enhancement, social, and conformity motives. These four motives reflect an underlying two dimensional model originally used in the drinking motives literature including valence (positive or negative reinforcement) and the source of outcomes expected (internal or external) (Cooper, 1994; Cox & Klinger, 1988). Coping refers to using substances to regulate or reduce negative internal emotions while conformity refers to avoiding negative social consequences. Enhancement and social motives reflect positive reinforcement, and refer to wanting to increase positive mood or well-being or obtain positive rewards respectively.

It is also argued by some authors that different motives for using substances are motivated by different needs and therefore associated with specific consequences (Kuntsche et al., 2005). For instance, it is clear from the literature that those who have more problematic drinking are those who are more likely to drink for individual reasons, including changing their mood state (coping and personal enhancement motives), rather than drinking for primarily social (including conformity) reasons (Doyle et al., 2011). While social reasons for drinking are still relevant for those seeking treatment for substance use disorders, using substances to avoid negative social consequences, such as in conformity have been studied less in adult populations.

An article reviewing drinking motives within young people indicate that, at least initially, most youth drink primarily for social reasons, others indicated drinking for enhancement reasons and even less reported drinking for coping reasons (Kuntsche et al., 2005). While personal enhancement motives predicted difficulties, drinking for coping reasons, particularly drinking to cope with negative emotional states was found to be associated with the most alcohol-related problems. Another study specifically aimed at exploring substance use motives among young

people seeking mental health treatment reported that positive and negative drug effects, social reasons, and coping to be the most common reasons for use for both those with and without substance use disorders (Hides, Lubman, Cosgrave, Buckby, Killackey, & Young, 2008). The investigators reported that the participants with current substance use disorders scored higher on all the scales, with using substances for coping and drug effects being related to more severe symptoms and lower levels of functioning (Hides et al., 2008).

In the area of substance abuse and various co-morbidities, authors often discuss the possibility of self-medication as a type of coping motive, using substances in order to reduce psychiatric symptoms, including ADHD (Blume, Marlatt, & Schmaling, 2000; Rosenthal & Westreich, 1999; Wilens; 2004) The concept of self-medication was originally based on the work of Khantzian and has been termed the "self-medication hypothesis"; he suggested that those with psychiatric disorders often report choosing specific substances with compensatory stimulating or sedating action, such as those with ADHD choosing to use amphetamines rather than alcohol, due to its stimulating properties (1997). Further, the self-medication hypothesis suggests that this pattern of use predisposes them to addiction, as use of substances functions as a compensatory behavior in order to regulate affect and self-sooth for the purposes of coping, and achieving emotional stability (Khantizian, 1997; Suh, Ruffins, Robins, Albanese, & Khantzian, 2008).

The general substance use disorders literature is conflicted regarding this self-medication hypothesis, as certain substances may actually worsen psychiatric symptoms rather than relieve them. While the "dysphoria relief" has been found to be the most frequently endorsed reason for substance use among those with psychiatric problems (Gregg, Barrowclough, & Haddock, 2007), reducing negative emotional and cognitive states and augmenting positive states are also commonly cited reasons for using alcohol and other drugs (Carey et al., 1999). Self-medication

of psychiatric symptoms has been one of the least commonly endorsed reasons for use of substances within the literature, particularly in terms of alcohol or marijuana (Carey et al., 1999; Thornton, Baker, Johnson, Kay-Lambkin, Lewin, 2012). This is possibly because substances may actually exacerbate underlying psychiatric symptoms. One notable exception to this has been tobacco, which several studies suggest may be frequently used in a psychiatric population to medicate such symptoms (Carey et al., 1999; Thornton et al., 2012). Some point to the fact that some substances may in fact cause, as well as exacerbate current psychiatric disorders, and suggest a bio-behavioral rebound model to explain how substances can initially reduce and then later exacerbate symptoms (Blume et al., 2000). In any event, in its broader form self-medication refers to the motive to use alcohol or other drugs so as to change dysphoric affect that may be associated with comorbid problems.

In an Australian study of patients with serious mental illness in addition to substance use disorders, they examined the motives for use for alcohol, nicotine, and marijuana (Thornton et al., 2012) They found that in 64 participants, tobacco was used most frequently for coping motives, alcohol was associated most frequently with social motives, and marijuana was frequently used for pleasure enhancement motives (Thornton et al., 2012). In addition, they asked qualitative questions about motives for use, and found that substance use to cope was associated with using to cope with stress, escape reality, and self-medicate. Tobacco was most commonly associated with self-medication, but some participants also described using alcohol and marijuana to cope with mental illness symptoms (Thornton et al., 2012), which suggests that perhaps the patient *believes* that substances are, at least intermittently, reducing or alleviating their psychiatric symptoms (Blume et al., 2000). When they asked specifically about the impact of substance use on mental health, they found that tobacco was associated with positive mental

health effects, while alcohol and marijuana were associated with negative impacts on mental health (Thornton et al., 2012).

Notably, much of the motives literature in patients with comorbid substance use disorders has been conducted on patients with trauma and severe mental illness. One study mentioned earlier, examined the motives for use within non-psychotic youth (15-24) seeking treatment for mental health concerns, such as depression and anxiety, who had used alcohol or other drugs within the past year (Hides et al., 2008). They found that 27.5% of that population had comorbid substance use disorders, with alcohol and marijuana use disorders being most common. Those with comorbid substance use disorders were more likely to score higher on the motives for use scales, and those who endorsed motives for coping and drug effects (including positive drug effects such as helping them think/concentrate) were more likely to have higher levels of anxiety and depression, and lower levels of functioning (Hides et al., 2008).

The most recently developed measure for examining drinking motives is the Desired Effects of Drinking (DEOD) Scale developed as part of the national COMBINE study which examined combining cognitive behavior therapy (CBT) with medications (Doyle et al., 2011). The DEOD was used in the CBT conditions to assess and provide feedback to 572 adult patients seeking alcohol treatment regarding their motives for alcohol use and was used in their personal treatment plan. Analysis of the findings within this treatment seeking sample found that three general motives or factors (i.e., to reduce or control negative affect (coping), to increase positive affect (enhancement), and to socialize with others (social)) best described the motives for use (Doyle et al., 2011). In addition, these three general factors were further broken down into nine subscales tapping into various motivations to drink which could be used to provide the participants with specific feedback and in treatment planning. The subscales of the DEOD

include the following: to feel more powerful and courageous (Assertion); to get drunk, recover from a hangover, or sleep (Drug Effects); to feel more alert or increase concentration (Mental); to reduce negative affect (Negative Feelings); to relax or increase positive affect (Positive Feelings); to feel more satisfied and less disappointed with oneself (Self-Esteem); to find relief against problems and tension (Relief); to feel more romantic and sexually excited (Sexual Enhancement); and to be sociable and comfortable in social settings (Social Facilitation). Within this treatment-seeking population, coping motives were found to be most strongly associated with drinking problems and drinking-related consequences (Doyle et al., 2011).

As much of the motive literature to date has been done on the general population, including adolescents and young adults, who endorse different motives for use than those with more severe problems with substance use, this study is important because it identifies motives associated with more problematic and severe use within a treatment seeking population. Unfortunately, although this study included those with comorbid mental health disorders, they did not analyze if those with different co-occuring disorders might have different profiles in terms of motivation for use.

Aside from the discussion of self-medication in the comorbid ADHD and substance abuse literature, the author could not find any studies empirically examining motives for drinking or substance use within an ADHD population. It might be predicted that coping motives generally, and more specifically mental effects related to improving concentration and focus, might be more implicated in those with ADHD given their difficulties with concentration and attention, and the impact on everyday adjustment.

Executive Functioning

It is difficult to define executive functioning due to the diversity of opinions regarding the exact nature and functions of executive functioning. However, the prominent symptoms involved in ADHD (including impulsivity and difficulties staying on task and being organized) clearly overlap with executive functioning. One definition of executive functioning within the field of substance abuse includes the ability to engage in goal driven activities which consist of the following components: planning, organizing, problem solving, decision-making, initiating and self-regulating behavior, working memory and motivation (Blume & Marlatt, 2009). Another definition that captures possible deficits in problem solving states:

> "The executive functions are a collection of processes that are responsible for guiding, directing, and managing cognitive, emotional, and behavioral functions, particularly during active, novel problem solving. The term *executive function* represents an umbrella construct that includes a collection of inter-related functions that are responsible for purposeful, goal-directed, problem solving behavior" (Gioia, Isquith, Guy, & Kenworthy, 2000, p. 1).

Deficits in executive functioning can impair an individual's ability to plan, and follow through on tasks. It can influence his/her ability to delay gratification in exchange for future oriented benefits, and can impair his/her ability to reach broader goals—such as successfully entering and completing substance abuse treatment.

Executive Functioning in ADHD

Adult ADHD appears to involve significant deficits in executive functioning in daily life (Barkely & Murphy, 2011). In fact, deficits in executive functioning are discussed as an underlying neuropsychological disorder, and current theories of ADHD place emphasis on the central role of attentional and executive dysfunctions. Barkley's model of ADHD proposes that ADHD is linked to behavioral inhibition and four other executive functions including: (1) working memory, (2) self-regulation of affect-motivation-arousal, (3) internalization of speech,

and (4) reconstitution (behavioral analysis and synthesis) (Barkley, 1997). The interaction of these elements inhibits individuals with ADHD to effectively self-regulate, and successfully engage in goal-directed behavior.

Although these deficits are widely accepted as integral to ADHD symptoms, their specific cause is still contested due to the difficulty of teasing out these specific deficits from other neurological processes. For instance, Halperin and Schulz (2006) proposed a neurodevelopment model of ADHD that suggests that that prefrontal cortex is not the only, or even primary, brain structure affected by ADHD. Rather, they suggest that the prefrontal cortex serves as a "top-down" regulatory or executive control for coordinating multiple systems within the brain (Halperin & Schulz). Their model is based on a review of the literature that points to the inconsistency regarding the specific deficits involved in ADHD, and the tendency of symptomatology of ADHD to remit somewhat over time, suggesting a neurodevelopmental course of ADHD (Halperin & Schulz). Although multiple studies with both children and adults with ADHD using neuropsychological testing have demonstrated measurable deficits in executive functioning, including: inhibitory control, regulation of attention, planning, working memory, and shifting sets, these results are not consistent (Halperin & Schulz), and ADHD symptoms may be only weakly correlated with neuropsychological tests of executive functioning (Barkley et al., 2008; Jonsdottir, Bouma, Sergeant, & Scherder, 2006). This has led some to suggest that ADHD is not a disorder of executive functioning, or only a subset has deficits in this area (Jonsdittir et al., 2006).

Barkley suggests that perhaps this conclusion is based on the erroneous assumption that executive functioning tests are the gold standard for the presence of deficits in executive functioning (Barkley & Murphy, 2011). He suggests that neuropsychological tests of executive

functioning may have low ecological validity. These tests tap into multiple cognitive processes besides just those of executive functioning, and sample such a small period of time, in which it is difficult to measure the full implication of difficulty with executive functioning specifically, and goal-directed behaviors in general (Barkley & Murphy, 2011), which the work of Halperin and Schulz seems to support. Rather, Barkley suggests that ratings of executive functioning in daily life may better measure the full range of difficulties across time, and created a scale to assess for deficits of executive functioning in daily life based —the Barkley Deficits in Executive Functioning Scale (B-DEFS) (Barkley & Murphy, 2011).

The B-DEFS was constructed based on current theories of executive functioning and represents five underlying dimensions of executive functioning: self-management to time, self-organization/problem-solving, self-discipline or inhibition, self-motivation, and self- regulation of emotions. Three groups were compared on the B-DEFS and a standard battery of executive functioning tests including: adults diagnosed with ADHD (*N*=146), a clinical control group of individuals with subclinical ADHD symptoms (*N*=97), and a community sample without ADHD (*N*=109). They found that those with ADHD reported more severe symptoms on the B-DEFS compared to either the clinical or community sample, but was not significantly related to the tests of executive functioning. In addition, most of the ADHD sample fell into the "clinical impairment" range on the B-DEFS, but only a minority were found to have clinical impairment based on the tests of executive functioning (Barkley & Murphy, 2011). Only two tests of executive functioning were found to share small but significant variance with the B-DEFS scale, the Continuous Performance Test (used to assess inattention and inhibition) and the Five-Points Test (used to assess nonverbal working memory and fluency). They concluded that ADHD does involve substantial difficulties with executive functioning in daily life, and that these difficulties

were more likely to be associated with rating of executive functioning, rather than tests of executive functioning (Barkley & Murphy, 2011). In fact, deficits in such areas may have significant implications for substance abuse treatment outcomes that require long term goal-directed behaviors, such as treatment retention and consistent focus on intermediate life goals.

Executive Functioning in Substance Abuse

There is also literature that indicates deficits in executive functioning accompany substance abuse and may be linked to the abuse of a wide range of addictive substances (Blume & Marlatt, 2009; Vik, Cellucci, Jarchow, & Hedt, 2004). In a review of different substances and their effect on neuropsychological functioning, there is consistent evidence across substances that they negatively impact executive functioning, attention, learning, memory, and visual spatial abilities, and may be robustly associated with impulsivity, working memory, and decision-making (Yücel, Lubman, Solowij, & Brewer, 2007). However, most studies are cross-sectional in nature, making it difficult to determine if the deficits are as a result of the substance abuse, related to pre-existing vulnerabilities, or some combination of both. There is likely an intricate relationship between pre-existing neuropsychological vulnerabilities, age of initiation of substance use, and patterns of substance use (Blume & Marlatt, 2009; Vik et al., 2004).

The development of brain structures continues to mature into early adulthood, particularly the frontal lobe which has been linked to the regulation of executive functioning and memory. Preexisting deficits in executive functioning may predispose some individuals to substance use disorders, which in turn exacerbate their deficits in executive functioning (Giancola & Tarter, 1999; Nigg et al., 2004). Long-term, heavy drug use or alcohol use also has been demonstrated to influence the neuroanatomy of the brain, as well as influence neuropsychological functioning. More robust, longitudinal research is needed in order to determine the degree to which such

executive functioning deficits are present prior to, or are more a result of substance use (Giancola & Tarter, 1999).

In addition, similar to the literature of attention and executive functioning, it is difficult to tease out the effects of substance use disorders on executive functioning due to the conflicting literature with small sample sizes and heterogeneous samples, and different tests of executive functioning. For instance, when looking at heavy social drinkers within non-clinical participant samples, a meta-analysis concluded that the literature has not always produced consistent results in this area, and that this may be a function of not comparing heavy social drinkers to normal drinkers and the number and type of executive functioning tasks administered (Montgomery, Fisk, Murphy, Ryland & Hilton, 2012). In addition, different tasks were used in each of the studies they analyzed which they determined was problematic because these tests of executive functioning used may involve additional neural structures than the tests were designed to administer, possibly confounding results (Montgomery et al., 2012). They concluded that additional research was needed to determine if it was methodological limitations that produced inconsistent results. These authors conducted another study, which compared forty-one college student non-clinical participants on their level of alcohol use, and found that those who were heavier social drinkers exhibited deficits in executive functioning tests compared to their peers, particularly on tasks of switching, inhibition, and access to semantic memory (Montgomery et al., 2012).

Several studies have examined self-report measures that tap into components of executive functioning (Heffernan, Moss, & Ling, 2002; Lyvers, Duff, & Hasking, 2011). Lyvers, et al found a significant relationship between risky drinking and self-reported deficits in executive functioning within their sample of 132 adults ages 16-68 years of age. Within a community

sample, they examined several variables related to risky alcohol use, including motives for use such as reward sensitivity and sensitivity to punishment, as well as a self-report frontal lobe measure that examined apathy, disinhibition, and executive dusfunction (Lyvers et al., 2011). They found that impulsivity, reward sensitivity, and family history of alcoholism were related to more risky drinking, which may influence the predisposition to heavier and riskier alcohol use. Specifically, they found that rash impulsiveness and sensitivity to reward, defined as the degree to which behavior tends to be motivated by positive reinforcement, or inhibition of behavior, partially mediated the relationship between disinhibition and drinking behavior which often leads to riskier and more problematic alcohol consumption.

Another study using a self-report measure examined prospective memory, which refers to the memory for future events or remembering to do things at some future point in time (e.g. attend appointments) (Heffernan et al., 2002). Working memory and executive functioning processes are closely related, as the working memory capabilities may influence an individual's ability to manipulate information needed for executive functioning (Piechatzek et al., 2009). Heffernan's study examined heavy social drinking young adults from a community sample that had never been diagnosed as alcohol dependent. Thirty participants in the heavy, chronic group were compared to thirty participants in the low-dose/alcohol free group on a self-report measure of prospective memory including short-term habitual prospective memory (e.g. "I forgot to turn my alarm clock off when I got up this morning"), long-term episodic prospective memory (e.g. "I forgot to pass on a message to someone"), and internally cued prospective memory (e.g. "I forgot what I wanted to say in the middle of a sentence"). They found that the chronic heavy alcohol group reported significantly more deficits in all types of prospective memory, and the results remained significant even when controlling for the use of other drugs, as well as the number of

strategies that they used to help aid their memory (Heffernan et al., 2002). Taken together, these studies suggest that executive functioning deficits are able to be examined using self-report scales, and that there are significant differences in terms of memory and executive functioning deficits depending on amount of alcohol consumed.

Combined Influences

Deficits in executive functioning appear to be a construct that is very relevant to both ADHD and young adults with substance abuse problems. Pre-existing deficits in executive functioning among ADHD adolescent and young adults may put them at greater risk for problematic involvement with alcohol and other drugs. Early use would then be predicted to exacerbate problems in executive functioning. Consequently, individuals with co-occurring ADHD and substance abuse might be expected to exhibit even greater difficulties in executive functioning possibly across more domains.

Purpose of the Present Study and Research Questions

There is considerable literature documenting that ADHD is a risk factor for the development of substance abuse problems and that, in fact, a significant portion of young adults in substance abuse treatment (as many as 20%) have unrecognized ADHD (van Emmerik-van Ootmerssen et al., 2012). Although there have been many studies that have demonstrated an increased prevalence of ADHD within a substance abuse population, this study sought to extend the literature by researching possible differences characterizing substance abuse patients with ADHD, particularly differences that could have implications for better serving such patients in treatment. Based on the preliminary reported negative outcomes for patients with comorbid ADHD and substance use disorders, it is proposed that substance use patterns, motives for use, and executive functioning are potential key differences that could have implications for treatment

planning among this subgroup of substance abuse patients. As this proposed project is the first attempt to characterize such differences, this study is exploratory in nature.

We hypothesize that young adults with comorbid ADHD and substance use disorders will differ from those with substance use disorders alone in key ways: 1) Individuals with comorbid ADHD will initiate alcohol use earlier, have problems with alcohol earlier and for a longer period of time, report an earlier first age of treatment for substance use disorders with more unsuccessful attempts to quit drinking. In addition, they may also use more substances, both licit (including nicotine), and illicit (including stimulants). 2) Individuals with comorbid ADHD may have a different profile of motives for drinking or stimulant use with greater coping motives, and particularly report using alcohol or other drugs for "mental" effects, and 3) Individuals with comorbid ADHD would be expected to report more problems in the area of executive functioning overall, and specifically may report more problems with self-management to time and self-activation/concentration.

CHAPTER 2: METHODS

Participants

Participants were recruited from a local outpatient substance abuse treatment facility and included 23 young adults ages 18-35 who were enrolled in substance abuse treatment and gave consent. The rationale for the age restriction was to focus specifically on young adults who are most likely to have problematic substance use disorders and continuing ADHD; however in order to increase the sample it was extended to age 35. They filled out a demographic information form including age, sex, race/ethnicity, marital status, as well as history about education, employment, and any prior diagnosis of a mood or attention disorder.

Participants fell into one of two groups based on a prescreening: those who have an alcohol and other drug use disorder diagnosis alone and those who have comorbid substance abuse and childhood and current symptoms of ADHD. Potential participants were excluded if they had cognitive confusion which would prohibit them from answering the self-report questionnaires or a history of brain injury, which could impair executive functioning independent of ADHD. One potential participant was excluded after completing a screening based on a history of traumatic brain injury. In addition, participants could not be acutely withdrawing from any substance (i.e., defined as no problematic use for the month prior to data collection), as active use or acute withdrawal would be expected to affect results.

Procedures

Participants were recruited in a variety of ways. First, researchers worked with the substance abuse agency and their counselors to get out word about the study. The primary investigator met with counselors and staff at the substance abuse agency and invited them to refer potential participants. In addition, 1-page recruitment flyers were posted about the study

inviting participants to contact their counselor or the researcher for more information, and study researchers met with therapy groups and described the study and invited interested parties to complete a prescreen. All potential participants went through the informed consent process (see Appendix A) and completed the pre-screen to determine if they qualify for the study. If they qualified, they completed the rest of the measures and received a $10 Walmart gift card for participation.

Potential participants were identified and classified into the study groups based on their scores on two pre-screening measures, the Wender Utah Rating Scale and the Adult ADHD Self Report Scale (ASRS), assessing childhood and adult symptoms of ADHD respectively. Participants needed to score above a 46 on the Wender, and endorse 4 of 6 current symptoms on the ASRS to be included in the comorbid ADHD group, or score less than 36 on the Wender and endorse no more than 2 of 6 current symptoms on the ASRS to be included in the substance use only group.

Although only 23 participants completed the study and were included in the final sample, another 14 possible participants were screened. Of those 14 possible participants, 7 met criteria and qualified for the study based on the results of their prescreening, but were unable to be contacted to complete the study. The other 7 possible participants did not meet criteria for the study, based on the results of their prescreening measures. Either they exhibited some attentional symptoms during childhood, but did not endorse adequate current symptoms to be included (N=4), or they did not endorse childhood attentional symptoms, but endorsed more than two current symptoms (N=3).

All interviewing and data collection occurred individually in a private room at the substance abuse agency. Once participants consented to participate, they completed a semi-

structured research interview with embedded self-report measures. The interviewers were trained to conduct these interviews in a standardized fashion providing participants help as needed with the self-report measures. All the participants completed the measures in the same specified order so as to control for possible questionnaire effects. Specifically, participants first completed a demographic/background form, and then a lifetime substance use interview examining ages and patterns of use as well as treatment history. (See Appendix B for measures developed for this study.) Next, they were asked to fill out self- report measures related to conduct problems experienced growing up and their motives for substance use. Lastly, all participants completed the Barkley executive functioning measure. For those not reporting ADHD symptoms, the interview ended and they were thanked for their time. Those who screened positive for ADHD, also completed a further diagnostic interview assessment (CIDI ADHD module) confirming ADHD symptoms and addressing their ADHD history and impact of their symptoms. Finally, comorbid participants were also asked a few qualitative questions so as to allow them to briefly discuss the impact they think their ADHD had on their substance use and the kind of help they think individuals with co-occuring ADHD may need within substance abuse treatment. The entire interview and evaluation process lasted between half an hour and an hour and a half for all participants.

Measures

ADHD Screening (WURS/ASRS)

Wender Utah Rating Scale (WURS) for Attention Deficit Hyperactivity Disorder

The Wender Utah Rating Scale (WURS-25) is used to assess childhood Attention Deficit Hyperactivity Disorder retrospectively within adults (Ward Wender, & Reimherr, 1993). There are a total of 25 questions specifically associated with the ADHD diagnosis answered by the

adult participant rating their childhood behavior on a 5-point Likert (0-4) scale. The total score is calculated by the sum of the item responses. The recommended cutoff score for this instrument is 46, and indicates that the participant likely has had ADHD.

The measure was developed based on a combination of the Utah Criteria and DSM-IV criteria, and was created specifically for retrospectively diagnosing ADHD in adults based on childhood symptoms (Wender, 1995). The WURS-25 demonstrates excellent psychometric properties, and in a recent systematic review of scales used to identify adults with ADHD, it was listed as having the best combination of psychometric properties overall compared to other scales (Taylor, Deb, & Unwin, 2011), particularly when used in conjunction with the Adult ADHD Self-Report Scale-Version 1.1 (Dakwar et al., 2012). Used alone, it has demonstrated high internal consistency reliability (r=.86-.92). In addition, the WURS-25 also was shown to have excellent specificity (96%) as well as sensitivity (96%) at the cutoff of 46 (Taylor et al., 2011). In the present study, alpha for the WURS using the total sample was .96.

The Adult ADHD Self-Report Scale—Short Form (ASRS)

The Adult ADHD Self-Report Scale—Short Form (ASRS) was developed by the World Health Organization to assess Attention Deficit Hyperactivity Disorder symptoms within adults. The short form has only six items, on which participants rate their current symptoms on a 5-point Likert (0-4) scale. If participants endorse 4 of the 6 items with adequate severity, it indicates that the participant likely has ADHD. When compared to the longer 18 question version of the ASRS, the short version performed better overall in sensitivity (68.7% vs. 56.3%), specificity (99.5% vs. 98.3%), and total classification accuracy (97.9% vs. 96.2%) (Kessler et al., 2005). Alpha for the six ASRS items was .85. Participants who scored greater than the cutoff score of 46 on the WURS and endorsed 4 of 6 items with adequate severity on the ASRS were included

in the comorbid ADHD and substance abuse group, although ADHD criteria were confirmed using a structured interview.

Those patients who scored low on these same measures (WURS-25, ASRS) were eligible for the comparison group. As a working guide and based on some research by McCann, Scheele, Ward & Roy-Byrne (2000), it was decided that those below a cutoff score of 36 on the WURS, *and* who also did not endorse more than two items of adequate severity on the ASRS be considered as not having ADHD symptomatology.

Substance Abuse History Measures

Participants were interviewed regarding their substance abuse history, based on a modified version of the Drug History Questionnaire (DHQ) (L. C. Sobell, Kwan, & Sobell, 1995). The DHQ assesses for participant's lifetime and recent drug use across different drug classes including: alcohol, cannabis, stimulants, benzodiazepines/tranquilizers, sedatives/hypnotics, opioids, hallucinogens, inhalants, steroids, and illegal use of prescription drugs (Sobell et al., 1995). When comparing substance users on their DHQ at two different points in time, the significant correlations between these interviews were in the moderate to high range (r=.53-.93) with greatest consistency for reporting heroin and narcotics use, and lowest for hallucinogens and stimulants (Sobell et al., 1995).

The DHQ uses cards to help participants accurately recall their drug use, by first sorting those substances they have never used from those that they have used at least once. For those drugs that they have used once or more, they are asked to indicate those which they have used on a frequent or regular basis as opposed to once or twice experimental use. For those drugs used more than once, additional information was collected, including: age at first use, last use, total years used, total years of problematic use, frequency in the past 6 months, and route of

administration. Within the interviews, participants were asked about their primary drug of choice when it became clear that many of the patients abused opioids, rather than alcohol as we initially expected. In addition, questions were asked about attempts to quit and treatment history. The latter questions cover age at first treatment and the number of treatment episodes for alcohol and other drugs as well as longest period in treatment and longest period of abstinence. These treatment questions were primarily taken from the Addiction Severity Index, a semi-structured interview used for treatment planning and evaluation in substance abuse clinics (McLellan, Luborsky, Woody, & O'Brien, 1980).

Conduct Problems Measure

In order to assess and control for the possible associated effect of conduct problems within this population, all participants were briefly screened for a history of conduct problems in childhood and adolescence. There were a total of 15 yes/no questions asked about conduct problems, based on the DSM-IV criteria for conduct disorder (American Psychiatric Association, 2000). These childhood conduct questions were taken from the SCID-II Personality Disorder screening instrument and map on to the DSM-IV childhood criteria for antisocial problems.

Desired Effects of Drinking (DEOD)

Based on the idea that those with ADHD may use substances for different motives (ie, self-medication, mental effort, coping), we used a modified version of the Desired Effects of Drinking (DEOD) Scale to measure different motives for using various substances. This 36-question self-report scale described by Doyle, et al. (2011) was designed to assess reasons or motives for drinking. In addition to measuring respondents motives for drinking, we also asked them to rate their motives for using illicit substances, either stimulants, opioids, or marijuana, depending on their primary drug of choice and substance history. There are three primary or

overarching motives for use that the DEOD measures: coping, social, and enhancement. In addition, these factor scores are further broken down into nine subscales measured by four questions each. These subscales include: negative feelings, self-esteem, relief, drug effects, social facilitation, sexual enhancement, positive feelings, assertion, and mental effects. Respondents were asked to consider how often they have used substances to achieve any of these desired effects. Each question was rated on a 5-point Likert scale (0=never, 1=sometimes, 2=often, 3=almost always, 4=always). Although one can obtain a total score for the DEOD measure, more emphasis is placed on scores of the three factor scores and individual subscales.

In a study looking at the DEOD measure within a clinical population seeking treatment for their alcohol dependence, the reliability of the three primary subscales was found to be: coping motives (r=.78), social motives (r=.83), and enhancement motives (r=.99) (Doyle et al., 2011). Reliability estimates for each of the nine subscales were moderately good to high. Only the drug effects and positive feelings subscales fell below a reliability estimate of .70, with their reliabilities measured at .57 and .67 respectively. Considering each of these subscales is comprised of only four questions, these may be acceptable values. In the present study, we found that for alcohol motives, internal consistency for the entire measure was high (α=.98) as well as for each of the three primary factors (coping (α=.97), social (α=.95), and enhancement motives (α=.90)).

Consistent with the literature showing motives are proximally related to substance use, when the DEOD was compared to measures of post-treatment alcohol consumption, Doyle et al. found that the DEOD total score significantly predicted drinks per drinking day ($F_{1, 441}$=9.20, p=.0026), and percent days abstinent ($F_{1, 559}$=12.64, p=.0004), where more endorsed motives was related to greater alcohol consumption and less abstinence from alcohol (2011).

Barkley Deficits in Executive Functioning Scale (B-DEFS)

This 91-question self-report scale designed by Barkley and Murphy (2011) is based on executive functioning theories (Barkley, 1997) and was specifically tailored to assess tasks of executive functioning in adults with ADHD. The scale items focus on problematic symptoms, or deficits, rather than on positive or normative executive functioning in the participant's everyday life. Respondents rated the frequency of various behaviors 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, 1=sometimes, 2=often, and 3=very often) including: self-management to time, self-organization/problem solving, self-restraint (inhibition), self-motivation, and self-regulation of emotions. The self-management to time factor deals with sense of time, time management, planning, preparing for deadlines, and other goal-directed behaviors. The self-organization/problem solving factor focuses on thinking quickly when confronted with unexpected events, and to organizing one's thoughts and actions. The self-restraint or inhibition factor deals with making impulsive decisions, and doing things without regard for the consequences. The self-motivation factor deals with needing more supervision than others when working, getting bored easily, and not doing all of assigned work. Finally, the self-regulation of emotions factor focuses on being easily distracted when doing boring work, being able to persist at boring activities, and sustained attention.

The internal consistency of each B-DEFS subscale was reported as follows: self-management to time, .95; self-organization/problem solving, .96; self-restraint, .93; self-motivation, .91; and self-regulation of emotions, .95. The internal consistency for the total executive functioning score was .92. Test-retests reliability was assessed after a period of 2-3

weeks after initial testing, and found to be .84 for the total scale score, which is quite satisfactory given that the scores did not change significantly over this interval (Barkley & Murphy, 2011). In this study, we also found the internal consistency of the B-DEFS to be quite high. The alpha reliability for the total score was .99, and alphas for the subscales were as follows: self-management to time, .97; self-organization/problem solving, .96; self-restraint, .95; self-motivation, .96; and self-regulation of emotions, .95.

In terms of validity, this scale has not only demonstrated the ability to discriminate those with ADHD from controls, but also is reported to have significant associations with various measures of impairment in life activities including: occupational and educational functioning, social relationships, driving, and financial management (Barkley & Murphy, 2011).

Composite International Diagnostic Interview (CIDI)

The World Health Organization Composite International Diagnostic Interview (CIDI) module for ADHD was administered to all participants that screened positive (WURS, ASRS) for a history of childhood and current ADHD symptoms in order to confirm that they meet ADHD criteria. The CIDI version 3.0 is a fully structured, lay administered interview developed by the World Health Organization. The CIDI asks a series of yes-no and symptom frequency questions, rather than using more open-ended probes in other instruments. It has been shown to be a reliable and valid instrument (Haro, Arbabzadeh-bouchez, Brugha, deGirolamo, Guyer, Jin, et.al, 2006). To determine the diagnostic concordance of the CIDI, a general clinical appraisal study was carried out with samples in France, Italy, Spain, and the United States. Diagnoses were compared using follow-up interviews with the Axis 1 research version of the Structured Clinical Interview for DSM-IV (SCID). In addition to the overall reappraisal sample (n=325), more focused clinical samples were used to validate several specific CIDI diagnosis, including

adult ADHD (n=154). The investigators found moderate to good individual level CIDI-SCID concordance for most psychiatric disorders when considering lifetime prevalence. Another measure of classification accuracy used in diagnostic studies is the area under the ROC curve as this measure is reportedly not influenced by the prevalence of disorders. This statistic was 0.76 overall for the dichotomous lifetime individual-level classification for the majority of diagnoses assessed; for the specific diagnosis of ADHD in adults, the area under the ROC curve statistic was substantial at 0.86 (Haro et al., 2006). The CIDI ADHD module was administered via the paper version to ADHD and substance abuse participants. Participants were reminded that in answering the questions, they should think of themselves when not under the influence and to consider periods of time in their life when they have been abstinent from alcohol and other drugs.

Qualitative Questions about ADHD and Substance Use

Given the exploratory nature of the present study, in addition to the quantitative self-report measures, participants classified as having ADHD symptoms were also asked several qualitative questions so as to allow them to briefly discuss the relationship they think their ADHD has had on substance use. They were also asked open-ended questions about the impact of ADHD symptoms on treatment and recovery, and how treatment might better address their specific needs. The questions allowed participants to reflect on their experiences, and elaborate on their responses. The specific questions included the following: 1) How do you think your difficulties with attention have influenced you use of alcohol and/or other drugs? 2) Do you think your drinking (or any other drug use) improved, worsened, or had no impact on your ADHD symptoms? 3) How do you think your difficulties with attention have influenced your efforts at recovery and/or treatment experience(s/success? What was difficult for you? 4) How could

alcohol and/or other drug treatment better help individuals with co-occurring attention problems? What do you think you need more help with or other suggestions?

Ethical Issues

The proposed study included attention to several important ethical issues. These were assuring that there was no coercion to participate and obtaining fully informed consent, confidentiality considerations, minimizing distress on participants, and protecting them from any potential harm. The study was approved by the university Institutional Review Board (IRB) (see Appendix A), as well as the agency's internal research review committee. Participant recruitment and the informed consent process and written statement were also specifically approved by the IRB. It was explained to potential participants that they did not have to participate and that whether or not they participate would not affect their treatment at the agency or access to any services. Confidentiality of the information provided in the interviews was assured with the exception of imminent risk of harm to self or others. We made every effort to ensure that participants' confidentiality was protected, including having participants' names only appear on the informed consent, and otherwise using a coded ID number thereafter.

Reporting on psychosocial and/or health related topics, including drug and alcohol use and deficits in executive functioning, could conceivably be distressing for a participant. However, the risk for this was seen as minimal given participants had entered treatment and the study questionnaires have been used many times in prior research. The informed consent specified that participants did not have to answer any question they do not wish to answer. Moreover, most substance abuse patients actually benefit from telling their story to a concerned listener who is encouraging them in their efforts toward recovery. Another related risk considered was that of labeling. It was explained to the ADHD participants that the evaluation of

their attention and related factors was for the purpose of research and not a clinical diagnosis. ADHD participants were encouraged to discuss their attentional problems and possible need for further evaluation with their counselor and physician for additional or supplemental treatment recommendations.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 19 SPSS Inc. The major research questions are related to describing associated differences and predicting the likelihood of group membership based on three domains: substance use patterns, motives for drinking and stimulant use, and executive functioning. Descriptive statistics were used to describe the demographic information for the participants as well as for each of the predictor variables within these domains. As this was an exploratory study into an area that has not been heavily researched, the groups were initially contrasted on variables in each domain. Independent-samples t-tests or chi-square tests were used to assess for initial differences, with statistical significance set at $p < .05$.

Correlation analyses were performed to examine the associations among measures within these domains as well as between significant substance use variables, motives for use subscales, and executive functioning subscales. The main research questions were analyzed using binary logistic regression analyses to predict likelihood of group membership based on the significant associated predictor variables. In order to compare odds ratios among predictors, variable scores were standardized. These analyses were also conducted controlling for conduct disorder symptoms, to see if predictors remained significant.

CHAPTER 3: RESULTS

Descriptive Statistics

The study sample was briefly described under participants in the method section. Table 2 provides descriptive statistics on the demographic characteristics of the final study sample by group. There were 13 participants with ADHD and Substance Abuse and 10 comparison participants with Substance Abuse only. The mean age of the sample was 25.5 years (SD = 4.2), with the comorbid ADHD group being slightly older (26.4 years) than the substance use only group (24.2 years).

The final sample included more women than men (60.9% vs. 39.1%), and more Caucasians than minorities (60.9% vs. 39.1%), but groups did not differ significantly on any demographic variables. The average number of years of education was 12 years (SD = 2.6), with the comorbid group having on average, slightly more education (12.7 years, SD = 3.1) than the substance use only group (11 years, SD = 1.5). Although the majority of the sample was not currently enrolled in school (73.9%), more of the substance use only group reported attending school either part time (20%) or full time (20%), compared to 7.7% of the ADHD comorbid group attending either part time or full time. Interestingly, more of the substance use only group had repeated a grade than those with comorbid ADHD (40% vs. 10%), and more of those in the ADHD comorbid group had been suspended or expelled from school than their substance use only counterparts (92.3% vs. 70%) although the average rate of being suspended or expelled for both was high (82.6%). T-tests and Chi squares were used to evaluate these differences. However, with the small sample size, none of the demographic contrasts reached statistical significance.

Table 2. Demographics

Variable	ADHD+SUD (N=13)	SUD Only (N=10)	Total Sample (N=23)
Age in years (mean, SD)	26.42 (4.04)	24.20 (4.26)	25.48 (4.20)
Sex			
Females	9 (69.2%)	5 (50%)	14 (60.9%)
Males	4 (30.8%)	5 (50%)	9 (39.1%)
Ethnicity			
Caucasian	9 (69.2%)	5 (50%)	14 (60.9%)
Minority status	4 (30.8%)	5 (50%)	9 (39.1%)
Education in years (mean, SD)	12.69 (3.12)	11.20 (1.48)	12.04 (2.60)
Marital status			
Single	5 (38.5%)	8 (80%)	13 (56.5%)
Married	3 (23.1%)	1 (10%)	4 (17.4%)
Separated/Divorced	3 (23.1%)	0 (0%)	3 (13%)
Cohabitating	2 (15.4%)	1 (10%)	3 (13%)
Current employment status			
Full time (35+ hours/week)	2 (15.4%)	4 (40%)	6 (26.1%)
Part time	3 (23.1%)	1 (10%)	4 (17.4%)
Unemployed	8 (61.5%)	5 (50%)	13 (56.5%)
Enrolled in school			
Full time student	1 (7.7%)	2 (20%)	3 (13%)
Part time student	1 (7.7%)	2 (20%)	3 (13%)
Not currently enrolled	11 (84.6%)	6 (60%)	17 (73.9%)
Repeated a grade	1 (7.7%)	4 (40%)	5 (21.7%)
Suspended or expelled from school	12 (92.3%)	7 (70%)	19 (82.6%)

Tables values shown as N (%) unless otherwise specified
All contrasts are non-significant

Group Classification

Consistent with the literature reviewed above and the intent of this project, participants were compared on multiple variables within the domains of substance abuse, motives for

substance use and executive functioning and these variables were then used to predict the likelihood of group membership as either those with co-occuring ADHD and an alcohol/ other substance disorder, or only an alcohol/ other substance use substance disorder. ADHD Status (i.e. classification variable) was based on scoring positive on both the Wender questionnaire screening for childhood ADHD symptoms and the Adult ADHD Self-Report Scale (ASRS) screening for current symptoms; the research diagnosis subsequently was confirmed with the CIDI Diagnostic Interview. In order to confirm that scores on the Wender and ASRS measure adequately differentiated the two groups, independent samples t-tests were conducted.

Table 3. Group Comparison

Variable	ADHD+SUD (N=13)	SUD Only (N= 10)
Score of Wender Utah Rating Scale	58.23 (11.38)	15.40 (10.21)**
Score of ASRS	15.77 (2.68)	5.80 (2.53)**
Conduct disorder items endorsed	3.08 (2.43)	.40 (.70)**

Tables values shown as Mean (SD)
**Significant at <.01

Table 3 shows average score for the ADHD comorbid group on the Wender Utah rating scale were significantly higher than scores of the substance use only group on the same measure $t(21) = 9.35$, $p = .000$. On the ASRS, scores of those with comorbid ADHD were significantly higher than scores of the substance use only group $t(21) = 9.05$, $p = .000$. These results confirm that based on prescreening, these groups clearly differed in terms of self-reported childhood and current ADHD symptoms.

The presence of diagnostic criteria for the ADHD group also was confirmed by the use of the CIDI ADHD module. This interview measure confirmed that all 13 participants initially identified as meeting the diagnostic criteria for ADHD based on the results of their prescreening,

indeed met criteria for ADHD either for inattention, hyperactivity or combined. Specifically, two (15.4%) of the ADHD sample participants reported difficulties primarily with inattention, and two (15.4%) of the ADHD sample participants reported difficulties primarily with hyperactivity/impulsivity. The remaining nine (69.2%) reported difficulties with both inattention and hyperactivity, meeting the research diagnosis of ADHD, combined type. When asked about previous diagnosis of ADHD, nine of 13 (69.2%) participants in the ADHD group reported that they had been diagnosed with ADHD in the past. Eight of the thirteen had been prescribed stimulant medication, but it was unclear if they were taking these medications currently, or had only been prescribed them in the past.

When participants with either primarily inattention or combined type were asked when they first noticed symptoms of inattention, they reported on average age 8.55 (SD = 4.03). Similarly, those with hyperactivity symptoms recalled that they first noticed these symptoms at age 8.08 (SD = 3.15). Participants were asked how much their ADHD symptoms have affected them over the past 12 months in various areas on a scale of 0-10, with one indicating no interference, and ten being very severe interference. Overall, participants reported "moderate" interference in the following areas, with the most difficulty with chores at home: chores at home (M = 6.46, SD = 2.47, N = 13), ability to do well in school or work (M = 6.00, SD = 2.57, N = 11), ability to get along with family (M = 5.08, SD = 2.66, N = 13), and social life (M = 4.92, SD = 2.29, N = 13).

In addition, we examined the associated relationship of childhood conduct problems which often covary with both ADHD and substance use disorders. There were assessed by the listing of 15 specific DSM-IV conduct problems on the SCID PDQ. We found that indeed the participants in the combined ADHD and substance use group, endorsed significantly more

conduct problems than the substance use only group $t(21) = 3.36$, $p = .003$. The scores on the SCID PDQ for the ADHD group ranged from 1 to 10, as compared to the substance use only group, whose scores only ranged from 0 to 2. The only conduct problems the substance use only group reported were stealing or shoplifting/forging signatures, and running away or staying away overnight; the ADHD and substance use group additionally reported staying out after curfew, and starting fights, as well as stealing or shoplifting/forging signatures, and running away or staying away overnight. As a result, as planned, the Conduct problems measure was employed as a control variable or covariate in logistic analyses below.

Research Questions

The major research questions are related to describing associated differences and predicting the likelihood of group membership based on three domains: substance use patterns, motives for drinking and stimulant use, and executive functioning. Descriptive statistics for each of the associated or predictor variables within these domains are reported including means and standard deviations. As this was an exploratory study into an area that has not been heavily researched, the groups were contrasted on variables in each domain. Although it is understood that the use of multiple tests increases the experiment wise error rate and potentially could lead to significant results due to chance, we were interested in identifying possible differences to be confirmed in future work given this is a pilot study. However, the overarching research question was addressed using hierarchical logistic regression analyses to predict likelihood of group membership based on the significant associated predictor variables.

Research Question #1: Substance Use Patterns

In terms of substance abuse and alcohol and drug treatment histories, which variables are associated with and predict comorbid ADHD /Alcohol and Other Drug Abuse?

Within the domain of substance use history, there were four broad categories of possible associated variables including:1) lifetime types of drugs used (including particularly abuse of stimulants) 2) total number of substances used and primary drug of choice 3) information about specific drug categories used including age of first use, problem use, route of administration (if applicable), and quit attempts and 4) treatment history including age of first treatment, number of treatments, and longest period in active treatment. More frequent stimulant use/abuse in the ADHD/Alcohol and Other Drug Abuse group was hypothesized, along with earlier age of onset of substance use.

Lifetime types of drugs used. Table 4 lists the percentages of participants who reported use of the various drugs on the Drug History Questionnaire. A Chi-squared test for independence was employed to determine the percentage of participants who reported using various substances based on if they were in the ADHD and substance use group or substance use only group. Interestingly, every participant reported using both alcohol and marijuana, and nearly every participant reported using nicotine. A significant difference between the two groups on substances use was only found for all stimulant use. Specifically, while 100% of the ADHD and substance use group reported use of illicit stimulants such as cocaine, only 40% of the substance use group reported using these substances χ^2 (1, N = 23) = 10.53, p = .001. Likewise, although nearly 40% of the ADHD and substance use group reported using non-prescribed stimulant medication such as Ritalin, none of the substance use only group reported using non-prescription stimulants χ^2 (1, N = 23) = 4.92, p = .027.

Table 4. Percentage of Participants Reporting Use of Various Substance

Variable	ADHD+SUD (N=13)	SUD Only (N=10)
Alcohol use	100	100
Nicotine use	100	90
Marijuana use	100	100
Stimulant use (meth, cocaine, etc.)	100	40***
Non-prescription stimulant use	38.5	0*
Benzodiazepine use	76.9	40
Opiate use	84.6	50
Inhalant use	38.5	10
Hallucinogen use	76.9	30
Sedative/Hypnotic use	7.7	0
Steroid use	7.7	0

Tables values shown as N (%)

*Significant at <.05, **Significant at <.01, ***Significant at <.001

Total number of substances used and primary drug of choice. Table 5 provides data on the total number of types of drugs used and the drug of choice of participants. An independent samples t-test was utilized to compare the groups in terms of the total number of substances they had utilized over their lifetime. Total number of reported substances of those with comorbid ADHD was significantly higher than the number of substances reported being used by substance use only group $t(21) = 3.21$, $p = .004$. To determine the differences between the groups on primary drug of choice, a Chi-squared test for independence was employed. The chi-squared analysis for primary drug of choice was not significant χ^2 $(3, N = 23) = 5.64$, $p = .131$, but the ADHD and substance use group had a larger percentage whose primary drug of choice was opiates.

Table 5. Primary Drug of Choice

Variable	ADHD + SUD (N=13)	SUD Only (N= 10)
Total number of substances used, lifetime	8.70 (2.53)	5.20 (2.66)**
Primary drug of choice (%)		
Alcohol	0 (0%)	0 (0%)
Marijuana	2 (15.4%)	4 (40%)
Stimulants	0 (0%)	1 (10%)
Opiates	11 (84.6%)	4 (40%)
Benzodiazepines	0 (0%)	1 (10%)

Tables values shown as Mean (SD) unless otherwise specified
*Significant at <.05, **Significant at <.01, ***Significant at <.001

Use of specific substances. Tables 6-11 provide substance use information for each of the specific drug categories. A combination of independent samples t-tests and chi-squared tests for were utilized to describe the specific patterns of use for individual substances. Only substances that had been frequently utilized by both groups were included in the analysis, specifically alcohol, nicotine, marijuana, stimulants (cocaine, meth, etc.), heroin and other opioids. Each substance was analyzed in terms of if the participants of the groups had ever utilized the substance, the age of first use, the total number of years used, and the route of administration (if applicable). In addition, it was noted if the participant endorsed that use of the particular substance was a problem for them, and if it was a problem, the number of years of problematic use. Finally, participants reported if they had ever attempted to quit the particular substance, and if they had attempted to quit but been unsuccessful, how many times they had tried to quit.

In terms of alcohol use, independent samples t-tests revealed that there were significant differences between the groups in terms of age of first use of alcohol, total years using alcohol, and number of unsuccessful quit attempts. As hypothesized, the age of first use of alcohol for

those with comorbid ADHD was significantly lower than the age of first use reported by the substance use only group $t(21) = -2.69$, $p = .014$. In addition, the total years using alcohol was significantly higher for the comorbid ADHD group than the total years of alcohol use reported by substance use only group $t(21) = 2.92$, $p = .008$. In addition, although more participants in the ADHD group had attempted to quit alcohol in the past (92.3% vs. 70%), the substance use only group reported significantly more unsuccessful attempts to quit alcohol than the ADHD and substance use group $t(21) = -2.38$, $p = .029$.

Table 6. Alcohol Use

Variable	ADHD + SUD (N=13)	SUD Only (N= 10)
Ever used (%)	13 (100%)	10 (100%)
Age of first use	13.15 (2.19)	15.60 (2.12)*
Total years used	11.38 (4.74)	5.70 (4.47)**
Endorsed Problem use (%)	4 (30.8%)	2 (20%)
Years of problem use	0.85 (1.57)	0.40 (.84)
Attempted to quit (%)	12 (92.3%)	7 (70%)
Unsuccessful quit attempts	0.00 (0)	0.78 (1.09)*

Tables values shown as Mean (SD) unless otherwise specified
*Significant at <.05, **Significant at <.01, ***Significant at <.001

Aside from alcohol variables, significant differences were found between the groups in terms of the age of first use for nicotine and marijuana. In terms of nicotine, the age of first use of the comorbid ADHD group was significantly lower than the age of first use reported by the substance use only group $t(20) = -2.63$, $p = .016$. Results for marijuana were similar, as the age of first use of marijuana for the comorbid ADHD group was significantly lower than the age of first use reported by the substance use only group $t(21) = -2.16$, $p = .043$.

Tables 9 through 11 provide the substance use information for stimulant, and opioids separating out heroin use. However, there were no significant differences between the groups involving these drugs.

Table 7. Nicotine Use

Variable	ADHD + SUD (N=13)	SUD Only (N= 9)
Ever used (%)	13 (100%)	9 (90%)
Age of first use	12.92 (1.94)	16.33 (4.10)*
Total years used	10.85 (5.41)	7.92 (4.96)
Endorsed Problem use (%)	12 (92.3%)	4 (44.4%)
Years of problem use	7.80 (6.14)	3.22 (5.59)
Attempted to quit (%)	11 (84.6%)	5 (55.6%)
Unsuccessful quit attempts	2.82 (3.00)	1.60 (2.07)

Tables values shown Mean (SD) unless otherwise specified
*Significant at <.05, **Significant at <.01, ***Significant at <.001

Table 8. Marijuana Use

Variable	ADHD + SUD (N=13)	SUD Only (N= 10)
Ever used (%)	13 (100%)	10 (100%)
Age of first use	14.00 (2.20)	16.00 (2.21)*
Total years used	9.46 (5.68)	6.10 (3.63)
Endorsed problem use (%)	5 (38.5%)	5 (50%)
Years of problem use	3.35 (5.79)	3.10 (4.88)
Attempted to quit (%)	11 (84.6%)	9 (90%)
Unsuccessful quit attempts	.64 (1.43)	1.89 (2.47)

Tables values shown as Mean (SD) unless otherwise specified
*Significant at <.05, **Significant at <.01, ***Significant at <.001

Table 9. Stimulant Use (cocaine, meth, etc.)

Variable	ADHD + SUD (N=13)	SUD Only (N= 4)
Ever used (%)	13 (100%)	4 (40%)
Age of first use	20.00 (4.23)	18.25 (2.06)
Total years used	3.35 (3.71)	4.25 (3.86)
Endorsed problem use (%)	4 (23.1%)	3 (75%)
Years of problem use	1.12 (2.81)	3.75 (4.35)
Route of administration (%)		
Oral	2 (15.4%)	0 (0%)
Nasal	11 (84.6%)	3 (75%)
Smoking	3 (23.1%)	1 (25%)
IV Injection	4 (30.8%)	0 (0%)
Attempted to quit (%)	11 (84.6%)	4 (100%)
Unsuccessful quit attempts	0.73 (1.68)	1.25 (1.89)

Tables values shown as Mean (SD) unless otherwise specified
All contrasts are non-significant

Table 10. Heroin Use

Variable	ADHD + SUD (N=8)	SUD Only (N= 4)
Ever used (%)	8 (61.5%)	4 (40%)
Age of first use	22.13 (4.42)	18.50 (3.11)
Total years used	4.57 (4.20)	3.33 (3.89)
Endorsed problem use (%)	7 (87.5%)	2 (50%)
Years of problem use	3.75 (4.37)	1.50 (2.38)
Route of administration (%)		
Oral	2 (25%)	1 (25%)
Nasal	6 (25%)	2 (50%)
Smoking	1 (12.5%)	0 (0%)
IV Injection	6 (75%)	1 (25%)
Attempted to quit (%)	8 (100%)	2 (50%)
Unsuccessful quit attempts	2.63 (3.42)	2.00 (1.41)

Tables values shown as Mean (SD) unless otherwise specified
All contrasts are non-significant

Table 11. Opioid use (besides heroin)

Variable	ADHD + SUD (N=11)	SUD Only (N= 5)
Ever used (%)	11 (84.6%)	5 (50%)
Age of first use	19.91 (4.03)	17.00 (2.00)
Total years used	5.67 (3.12)	4.25 (4.09)
Endorsed problem use (%)	10 (90.9%)	4 (80%)
Years of problem use	4.50 (3.72)	4.80 (4.08)
Route of administration (%)		
Oral	9 (81.8%)	4 (80%)
Nasal	7 (63.6%)	2 (40%)
Smoking	0 (0%)	0 (0%)
IV Injection	5 (45.5%)	1 (20%)
Attempted to quit (%)	10 (90.9%)	5 (100%)
Unsuccessful quit attempts	11.09 (29.61)	1.60 (2.07)

Tables values shown as Mean (SD) unless otherwise specified
All contrasts are non-significant

Treatment history. Table 12 reports on treatment variables. In terms of treatment history, independent sample t-tests again were conducted to determine the differences between groups. Surprisingly, the age of first treatment for the ADHD and substance use group was higher than that of the substance use only group but this difference fell short of statistical significance, two-tailed $t(21) = 1.08$, $p = .29$. Although the ADHD and substance use group reported a higher number of treatment episodes specifically for drugs than the substance use only group this difference also fell short of statistical significance, two-tailed $t(21) = 1.90$, $p = .071$. However, within treatment types, there was a statistical difference between the number of treatments specifically for drug detox with the ADHD and substance use group ($M = 1.00$, $SD = 1.23$, $N = 13$) reporting significantly more treatment for drug detox than the substance use only

group (M = .11, SD = .33, N = 13), $t(20) = 2.11$, $p = .048$. Otherwise, the groups did not differ on the number of substance abuse treatments or the longest number of days in treatment.

Table 12. Treatment History

Variable	ADHD+SUD (N=13)	SUD Only (N= 10)
Age of first treatment	21.77 (4.57)	19.90 (3.45)
Number of treatments for alcohol	0.00 (.00)	0.30 (.675)
Number of treatments for drugs	4.23 (3.35)	2.10 (1.29)
Drug Detox	1.00 (1.23)	0.11 (.33)*
Longest number of days in active treatment program	392.69 (598.38)	332.10 (540.54)

Tables values shown as Mean (SD)
*Significant at <.05, **Significant at <.01, ***Significant at <.001

Substance abuse logistic regression. A logistic regression analysis was conducted to predict the likelihood of group membership based on substance use variables that were found to be significant, including if participants utilized stimulants (cocaine and amphetamines), age of first use of alcohol, nicotine, and marijuana, and total number of substances used. A test of the full model verses a constant-only model was statistically significant, χ^2 (6, N = 22) = 29.77, $p <$ .000, indicating that the model was able to distinguish between respondents who were or were not included in the ADHD group. The model as a whole explained between 74% (Cox and Snell R square) and 100% (Nagelkerke R squared) of the variance in group classification, and correctly classified 100% of the cases.

Table 13 shows the logistic regression coefficient, Wald test, and odds ratio for each of the subscales. Employing a .05 criterion of statistical significance, none of the predictors had significant partial effects. The strongest predictors of ADHD classification were age that participants first used marijuana and nicotine. This indicated that respondents who reported earlier first use of nicotine and marijuana were more likely to be in the ADHD group than the

substance use only group, controlling for all other factors in the model.

Table 13. Logistic Regression Predicting Group Membership from Standardized Substance Use Variables

Predictor	*B*	SE	Wald	P	Odds Ratio
Stimulant use (cocaine, meth, etc.)	-655.21	52018.92	.000	.990	.000
Non-prescription stimulant use	21.06	13619.33	.000	.999	14042794.83
Total number of substances used, lifetime	-91.16	8339.01	.000	.999	.000
Age of first use, Nicotine	10.76	22139.99	.000	.991	3.649E+027
Age of first use, Alcohol	-315.03	24613.48	.000	.991	.000
Age of first use, Marijuana	63.46	5413.96	.000	.991	3.835E+067

All contrasts are non-significant

Research Question #2: Motives for Substance Use

In terms of reported motives for substance use, which variables are associated with and predict likelihood of comorbid ADHD /Alcohol and Other Drug Abuse? It was hypothesized that young adults with ADHD in addition to substance use disorders would have a different profile for motives for drinking, stimulant and opioid use, and report using alcohol, stimulants, and opioids more for coping motives, and particularly have higher scores on the scale "mental effects."

The major factor scores of the Desired Effects of Drinking (DEOD) questionnaire were examined as variables within this domain. The two groups were examined for significant differences in factor scores for alcohol use including: 1) coping, 2) social, and 3) enhancement. It was expected that individuals with comorbid ADHD might have a different profile of motives for substance use with greater coping motives, and particularly report using alcohol or other drugs for "mental" effects. Unfortunately, as alcohol was the only substance that the majority of

participants within both groups had used, we were only able to compare the groups on their alcohol use.

Table 14 lists the drinking motives scores by group on the DEOD, and independent samples t-tests were again conducted. None of the results were significant when the groups were compared on either the three factor scores, individual subscales, or total score. Total scores on the DEOD for alcohol use among the ADHD and substance use group did not differ significantly from total scores of the substance use only group $t(21) = .41$, $p = .68$. In terms of the factor scores, coping was found to be the highest primary motive for drinking among both the ADHD and substance use as well as the substance use only group but the difference between groups was not statistically significant, $t(21) = .50$, $p = .619$. Enhancement and Social motives also did not differ. Interestingly, drinking for mental effects was the least endorsed motive although again, this was not associated with group membership.

Table 14. Desired Effects of Drinking for Alcohol

Variable	ADHD+SUD (N=13)	SUD Only (N= 10)
Assertion	2.53 (3.71)	1.60 (2.32)
Mental	1.85 (2.08)	2.00 (4.14)
Drug Effects	4.61 (4.75)	4.10 (6.03)
Positive Feelings	8.92 (6.05)	7.50 (5.44)
Negative Feelings	5.08 (4.91)	3.50 (5.13)
Self-Esteem	4.46 (4.54)	4.1 (6.51)
Relief	7.38 (5.77)	5.40 (6.31)
Sexual Enhancement	4.62 (5.59)	4.30 (5.54)
Social Facilitation	6.77 (5.12)	6.90 (5.78)
Enhancement Subscale	13.31 (10.39)	11.10 (10.32)
Coping Subscale	21.54 (18.68)	17.10 (23.53)
Social Subscale	11.38 (10.36)	11.20 (10.29)
Total DEOD	46.23 (37.05)	39.40 (42.33)

Tables values shown as Mean (SD)
All contrasts are non-significant

Beyond looking at differences in these motives for alcohol, additional analyses were completed within the ADHD group examining motives across substances (see Table 15) for using alcohol, stimulants, and opioids, as unlike the substance use only group, the majority of the ADHD group had used stimulants and opioids in addition to alcohol. Differences between the motives for use endorsed across these substances among the ADHD participants were examined using a repeated measures analysis. In terms of the factor scores (i.e., enhancement, coping, and social subscales) and the total score on the DEOD, there was a significant difference in the extent to which ADHD participants endorsed motives for using opiates for both enhancement and coping motives. Specifically, participants in the ADHD and substance use group were significantly more likely to report using opiates for enhancement motives, than either alcohol or

stimulants Wilks' Lambada = .36, $F(2,8) = 7.11$, $p = .017$. Similar results were found for coping motives, where participants in the ADHD group were significantly more likely to report using opiates to cope than either alcohol or stimulants Wilks' Lambada = 29, $F(2,8) = 9.89$, $p = .007$. On the total score of the DEOD, participants were significantly more likely to report all motives for using opiates than either alcohol or stimulants Wilks' Lambada = .36, $F(2,8) = 7.18$, $p = .016$.

Table 15. Desired Effects of Use Across Drugs Among ADHD Participant Group

Variable	Alcohol (N=10)	Stimulants (N=10)	Opiates (N= 10)
Assertion	1.50 (2.51)	2.60 (4.22)	5.70 (6.73)
Mental	1.00 (1.41)	4.70 (4.85)	9.40 (6.60)
Drug Effects	2.80 (2.74)	2.70 (3.16)	9.30 (5.44)
Positive Feelings	7.30 (5.93)	6.80 (6.20)	12.70 (3.53)
Negative Feelings	3.10 (3.48)	3.70 (4.30)	9.30 (6.13)
Self-Esteem	3.50 (4.38)	3.50 (4.95)	8.40 (7.30)
Relief	6.00 (5.87)	4.90 (5.76)	11.50 (5.04)
Sexual Enhancement	3.50 (4.62)	1.80 (3.29)	6.00 (7.21)
Social Facilitation	5.60 (4.77)	5.20 (5.12)	8.20 (5.92)
Enhancement Subscale	9.8 (2.76)	14.10 (4.19)	27.80 (4.76)*
Coping Subscale	15.40 (4.99)	14.80 (5.61)	38.50 (7.05)*
Social Subscale	9.10 (3.84)	7.00 (2.51)	14.20 (4.06)
Total DEOD	34.30 (30.48)	35.90 (37.19)	80.50 (46.77)*

Tables values shown as Mean (SD)

*Significant at <.05, **Significant at <.01, ***Significant at <.001

In summary, participants with ADHD reported greater motives for opiate use than the other two drugs. This may reflect drug of choice in that for the ADHD group, 11 of the 13 (84.6%) reported opioids as their primary drug of choice.

There were no group differences on the motives measure which could only be examined by group for alcohol motives. As none of the alcohol motives for use variables were significant, a logistic regression analysis was not conducted to predict the likelihood of group membership based on motives for use.

Research Question #3: Executive Functioning

In terms of executive functioning, would executive functioning predict likelihood of comorbid ADHD /Alcohol and Other Drug Abuse? Specifically, it was hypothesized that those with comorbid ADHD would report more problems in the area of executive functioning overall, and specifically report more problems with self -management of time and self-activation/concentration.

The five subscales of the Barkley Deficits in Executive Functioning Scale (B-DEFS) were examined for possible associations with group classification and the total score served as a predictor variable of comorbid ADHD and Substance Abuse. The five major dimensions of the B-DEFS include: 1) self-management to time, 2) self-organization/problem solving, 3) self-restraint (inhibition), 4) self-motivation, and 5) self-regulation of emotions. Table 16 lists the mean B-DEF scale scores for each group along with normative comparison data from the B-DEFS manual.

Based on independent sample t-tests, the participants with comorbid ADHD and substance use disorders ($N = 13$) had significantly higher scores on all subscales of the B-DEFS than scores of participants with only substance use disorders ($N = 10$); in addition, the comorbid ADHD/ Substance abuse group scored higher than the participants from the normative sample.

The specific contrasts are depicted individually in Table 16. On the self-management to time subscale, scores of those with comorbid ADHD were significantly higher than scores of the substance use only group $t(21) = 3.49$, $p = .002$. For the self-organization/problem solving subscale, the scores of those with comorbid ADHD and substance use disorders were significantly higher than scores of the substance use only group $t(21) = 4.25$, $p = .000$. On self-restraint or inhibition, scores of those with comorbid ADHD and substance use disorders were

significantly higher than scores of the substance use only group $t(21) = 8.04$, $p = .000$. For self-motivation, scores of those with comorbid ADHD were significantly higher than scores of the substance use only group $t(21) = 2.99$, $p = .007$. For the self-regulation of emotions subscale, scores of those with comorbid ADHD were significantly higher than scores of the substance use only group $t(21) = 4.57$, $p = .000$. Finally, for the total score on the BDEFS, scores of those with comorbid ADHD were significantly higher than scores of the substance use only group $t(21) = 5.51$, $p = .000$.

Table 16. Barkley's Deficits in Executive Functioning Scale

Variable	ADHD+SUD (N=13)	SUD Only (N= 10)	Normative Sample[a] ADHD (N=146)	Clinical (N=97)	Community Control (N=109)
Self- management to time	55.31 (14.45)	35.00(12.91)**	45.9 (13.1)	40.3 (15.1)	6.1 (7.3)
Self-organization/problem solving	52.92 (15.27)	31.00 (6.08)***	33.1 (13.7)	27.4 (13.8)	4.9 (6.8)
Self-restraint (inhibition)	49.08 (7.73)	26.00 (5.37)***	39.2 (14.3)	33.2 (13.5)	5.3 (6.3)
Self-motivation	24.69 (9.02)	15.00 (5.46)**	17.3 (7.6)	13.5 (7.4)	1.9 (3.2)
Self-regulation of emotions	34.08 (6.17)	18.90 (9.73)***	22.9 (5.7)	20.6 (5.7)	3.8 (3.7)
Total BDEFS score	216.08 (43.14)	126.00 (32.27)***			

[a]Barkley & Murphy, 2011

*Significant at <.05, **Significant at <.01, ***Significant at <.001

Direct logistic regression was performed to assess the likelihood that their responses on the BDEFS would distinguish those with comorbid ADHD from those without. Standardized scores from the five subscales of the BDEFS were initially included. A test of the full model verses a constant-only model was statistically significant, χ^2 (5, N = 23) = 31.49, p < .000, indicating that the model was able to distinguish between respondents who were or were not included in the ADHD group. The model as a whole explained between 75% (Cox and Snell *R* square) and 100% (Nagelkerke *R* squared) of the variance in group classification, and correctly classified 100% of the cases.

Table 17 shows the logistic regression coefficient, Wald test, and odds ratio for each of the subscales. Employing a .05 criterion of statistical significance, none of the predictors had significant partial effects. The strongest predictors for attention difficulties were self-restraint or inhibition, and self-management to time. This indicated that respondents who reported difficulties with self-restraint/inhibition or self-management to time were more likely to be in the ADHD group than the substance use only group, controlling for all other factors in the model.

Table 17. Logistic Regression Predicting Group Membership from Barkley Deficits in Executive Functioning Subscales

Predictor	*B*	SE	Wald	P	Odds Ratio
Self- management to time	27.85	26653.65	.000	.999	1.249E+12
Self-organization/problem solving	-17.97	17215.52	.000	.999	.000
Self-restraint (inhibition)	176.74	28892.75	.000	.995	5.711E+076
Self-motivation	-17.18	23215.14	.000	.999	.000
Self-regulation of emotions	-72.24	15099.55	.000	.996	.000

All contrasts are non-significant

This analysis was also conducted controlling for childhood conduct problems. In addition to the five subscales of the BDEFS, the number of conduct disorder items respondents endorsed

was also included in block one. A test of the full model verses a constant-only model was statistically significant, χ^2 (6, N = 23) = 31.49, p < .000, indicating that the full model was able to distinguish between respondents who were or were not included in the ADHD group. The model as a whole explained between 75% (Cox and Snell *R* square) and 100% (Nagelkerke *R* squared) of the variance in group classification, and correctly classified 100% of the cases.

Table 18 shows the logistic regression coefficient, Wald test, and odds ratio for each of the predictors in the two blocks. Employing a .05 criterion of statistical significance, the number of conduct items endorsed had significant partial effects in block one, but none of the other predictors or blocks had significant partial effects. However, block 2 as a whole was able to significantly distinguish between respondents who were or who were not included in the ADHD group χ^2 (5, N = 23) = 13.66, p = .018. Aside from conduct disorder, the strongest predictor of group membership again was self-restraint or inhibition. This indicates that the BDEFS still distinguished the groups after controlling for conduct problems and that when controlling for all other factors in the model, participants who reported more difficulties with inhibition were more likely to be in the ADHD group.

Table 18. Logistic Regression Predicting Group Membership from Standardized Conduct Disorder and Barkley Deficits in Executive Functioning Subscales

Predictor	B	SE	Wald	P	Odds Ratio
Block 1					
Conduct disorder items endorsed	5.59	2.34	5.72	.017*	268.71
Block 2					
Conduct disorder items endorsed	49.72	26964.95	.000	.999	3.908E+21
Self- management to time	14.80	130213.38	.000	1.00	2680806.23
Self-organization/problem solving	-8.54	53445.72	.000	1.00	.000
Self-restraint (inhibition)	64.55	131596.18	.000	1.00	1.080E+28
Self-motivation	-7.57	83598.42	.000	1.00	.001
Self-regulation of emotions	-26.13	26834.16	.000	.999	.000

*Significant at <.05, **Significant at <.01, ***Significant at <.001

Summary Analyses of Group Prediction

Prior to running summary logistic regressions, zero-order correlations were computed to examine the relationships between the significant predictor variables from each of the domains discussed previously. Specifically, childhood conduct disorder problems, significant substance use history items (i.e., total number of substances used, stimulant use, and age of first use of nicotine, alcohol, and marijuana), as well as the three major subscales of the DEOD (enhancement, coping, and social), and the total BDEFS score were analyzed. Use of stimulants including cocaine and methamphetamine were positively related to number of conduct disorder items endorsed ($r = .418$, $p < .05$), and total number of substances used ($r = .691$, $p < .01$). Non-prescription stimulant use was positively related to numbers of substances used ($r = .634$, $p < .01$). Age of first use of nicotine was negatively related to simulant use ($r = -.604$, $p < .01$). Age of first use of alcohol was positively related to age of first use of nicotine ($r = .663$, $p < .01$). Age of first use of marijuana was negatively related to total number of substances used ($r = -.424$, $p <$

.05), non-prescription simulant use (r = -.514, p < .05), and positively related to age of first use of nicotine (r = .641, p < .01) and age of first use of alcohol (r = .707, p < .01).

The DEOD subscales were interrelated but the DEOD coping subscale for alcohol use was also positively related to stimulant use (r = .471, p < .05). Finally, the total score on the BDEFS measure of executive functioning was included as many of the BDEFS scales were highly correlated to each other. The total score on the BDEFS was positively related to number of conduct disorder items endorsed (r = .464, p < .05), as well as stimulant use (r = .454, p < .05), and negatively related to age of the first use of nicotine (r = -.533, p < .01), alcohol (r = -.504, p < .05), and marijuana (r = -.420, p < .05).

Table 19. Correlation of Major Variables

Variable	Conduct Disorder items endorse	Total Number of Substances used	Stimulant use	Non-prescription stimulant use	Age of first use, nicotine	Age of first use, alcohol	Age of first use, marijuana	DEOD, Enhancement	DEOD, Coping	DEOD, Social	Total BDEFS score
Conduct disorder items endorsed	1										
Total number of substances used, lifetime	.278	1									
Stimulant use (cocaine, meth, etc.)	.418*	.691**	1								
Non-prescription stimulant use	.208	.634**	.313	1							
Age of first use, Nicotine	-.390	-.401	-.604**	-.183	1						
Age of first use, Alcohol	-.231	-.258	-.235	-.312	.633**	1					
Age of first use, Marijuana	-.102	-.424*	-.374	-.514*	.641**	.707**	1				
DEOD enhancement subscale, alcohol	.293	.202	.349	-.145	-.294	.035	.047	1			
DEOD coping subscale, alcohol	.372	.305	.471*	-.126	-.325	.040	-.002	.915**	1		
DEOD social subscale, alcohol	.264	.305	.249	.005	-.285	.056	.058	.815**	.762**	1	
Total BDEFS score	.464*	.346	.454*	.304	-.533**	-.504*	-.420*	-.225	-.146	-.163	1

*Findings significant at <.05, **Findings significant at <.01, ***Findings significant at <.001

A hierarchical binary logistic regression analysis was employed to predict the probability of group membership based on significant variables discussed above. The predictor variables included conduct disorder which was entered into block one, and the total score on the BDEFS which was entered into block two. The remaining predictor variables, including number of substances used, stimulant use (both cocaine, meth, etc. and non-prescription stimulant use), and age of first use of nicotine, alcohol, and marijuana, were entered into block three. As the scores on the factor scores of the DEOD were not significant, those were not included in the logistic regression analysis. In order to compare odds ratios among predictors, variable scores were standardized. A test of the full model verses a constant-only model was statistically significant, χ^2 (8, N = 22) = 29.77, p < .000, indicating that the full model was able to distinguish between respondents who were or were not included in the ADHD group. The model as a whole explained between 74% (Cox and Snell R square) and 100% (Nagelkerke R squared) of the variance in group classification, and correctly classified 100% of the cases.

Table 20 shows the logistic regression coefficient, Wald test, and odds ratio for each of the predictors in the three blocks. Employing a .05 criterion of statistical significance, the number of conduct items endorsed had significant partial effects in block one, but none of the other predictors or blocks had significant partial effects. According to block 1, the odds ratio for conduct disorder items endorsed indicates that when holding the standardized score of all other variables constant, for each additional conduct item endorsed, a participant was 228.46 times more likely to be in the ADHD group than in the substance use only group. Although the full model analysis of all the variables reliably distinguished between those in the ADHD verses non-ADHD groups, there were no individual variables beyond reported childhood conduct problems identified as significant.

Table 20. Logistic Regression Predicting Group Membership from Standardized Conduct Disorder, Substance Use, and Deficits in Executive Functioning

Predictor	*B*	SE	Wald	P	Odds Ratio
Block 1					
Conduct disorder items endorsed	5.43	2.34	5.37	.02*	228.46
Block 2					
Conduct disorder items endorsed	1994.55	42734.67	.002	.963	-
Total BDEFS score	1333.53	23046.52	.003	.954	-
Block 3					
Conduct disorder items endorsed	7.73	10441.34	.000	.999	2272.50
Total BDEFS score	19.94	11173.04	.000	.999	458767301.37
Stimulant use (cocaine, meth, etc.)	20.96	33920.23	.000	1.000	1263057378
Non-prescription stimulant use	16.66	22520.86	.000	.999	17155566.99
Total number of substances used, lifetime	14.32	16424.60	.000	.999	1649478.39
Age of first use, Nicotine	10.76	22139.99	.000	1.000	46922.57
Age of first use, Alcohol	-17.88	15283.26	.000	.999	.000
Age of first use, Marijuana	9.34	18065.94	.000	1.000	11429.33

*Significant at <.05, **Significant at <.01, ***Significant at <.001

Finally, a second hierarchical binary logistic regression analysis was employed to predict the probability of group membership based on significant variables discussed above, with one small change. In order to compare the unique contribution of total score on the BDEFS compared to conduct disorder, BDEFS was entered into block one, and conduct disorder was entered into block two. As in above analysis, the remaining predictor variables, including number of substances used, stimulant use (both cocaine, meth, etc. and non-prescription stimulant use), and age of first use of nicotine, alcohol, and marijuana, were entered into block three. The test of the full model verses a constant-only model yielded the same results and was statistically significant, χ^2 (8, N = 22) = 29.77, p < .000, indicating that the full model was able to distinguish between

respondents who were or were not included in the ADHD group. The model as a whole explained between 74% (Cox and Snell *R* square) and 100% (Nagelkerke *R* squared) of the variance in group classification, and correctly classified 100% of the cases.

Table 21 shows the logistic regression coefficient, Wald test, and odds ratio for each of the predictors in the three blocks. Employing a .05 criterion of statistical significance, the total score on the BDEFS had significant partial effects in block one, but none of the other predictors or blocks had significant partial effects ($p = .006$). According to block 1, the odds ratio for total BDEFS score indicates that when holding the standardized score of all other variables constant, for each additional point added to the BDEFS score, a participant was 22.12 times more likely to be in the ADHD group than in the substance use only group. Although the full model analysis of all the variables reliably distinguished between those in the ADHD verses non-ADHD groups, there were no individual variables beyond total score on the BDEFS when entered in block one identified as significant, including conduct disorder. Combined with the above analysis, this indicates that both conduct disorder symptoms and BDEFS might be used to distinguish the groups. One caveat that might be pointed out is that this clear separation between groups might also be somewhat related to the way study participants were selected (high or low on ADHD symptoms, rather than including ADHD symptoms as a continuous variable).

Table 21. Logistic Regression Predicting Group Membership from Standardized Deficits in Executive Functioning, then Conduct Disorder and Substance Use Variables

Predictor	*B*	SE	Wald	P	Odds Ratio
Block 1					
Total BDEFS score	3.10	1.13	7.50	.006**	22.12
Block 2					
Total BDEFS score	1333.53	23046.52	.003	.954	-
Conduct disorder items endorsed	1994.55	42734.67	.002	.963	-
Block 3					
Total BDEFS score	19.94	11173.04	.000	.999	458767301.37
Conduct disorder items endorsed	7.73	10441.34	.000	.999	2272.50
Stimulant use (cocaine, meth, etc.)	-20.96	33920.23	.000	1.000	.000
Non-prescription stimulant use	-16.66	22520.86	.000	.999	.000
Total number of substances used, lifetime	14.32	16424.60	.000	.999	1649478.39
Age of first use, Nicotine	10.76	22139.99	.000	1.000	46922.57
Age of first use, Alcohol	-17.88	15283.26	.000	.999	.000
Age of first use, Marijuana	9.34	18065.94	.000	1.000	11429.33

*Significant at <.05, **Significant at <.01, ***Significant at <.001

Qualitative Analysis

Qualitative questions about the impact of ADHD on substance use and treatment were also analyzed in terms of the major themes. It was thought important to ask these 13 participants to describe their own experiences and challenges. Since these questions were exploratory and meant to fill a gap in the literature regarding how those with ADHD and comorbid substance use disorder might differ from those without ADHD, only the major themes across participants are described, particularly as related to explaining the quantitative findings.

Question 1. Participants were asked how their difficulties with attention have influenced their use of alcohol and other drugs. Nine of the 13 ADHD participants cited using substances to achieve certain effects, some related directly to their difficulties with attention, some more

indirectly. For instance, several mentioned using marijuana or opioids specifically to "help them concentrate," "slow thought processes down," "be less restless," and that "drugs would help [them] get things done." One mentioned that they "took the pills to be able to concentrate better, to get homework done. [The pills] cured ability to pay attention." They also reported using substances to more indirectly manage associated symptoms of attentional disorders, such as frustration or impatience, one reporting the use of substances rather than prescription medications when they "need[ed] something to help deal with feelings and emotions. When growing up, I was embarrassed to use medications."

However, some of the ADHD participants reported that their use of substances was unrelated to their attention difficulties. Specifically, one participant indicated that they "wanted to feel better about myself so I used drugs, and I don't feel it is because of attention problems." They reported that "if feeling restless or frustrated, I felt I needed to use substances to deal with it." Another indicated that they did not believe their substance use was related to their attentional difficulties as they reported that they used prescribed medications to manage their attentional symptoms, "[I] took Ritalin when 12 to manage symptoms of ADHD such as concentrating during school and notes."

Question 2. When participants were asked if drinking or drug use improved, worsened, or had no impact on their ADHD symptoms, eight of thirteen participants believed that their symptoms improved as a result of their drug use. One mentioned that their symptoms "improved in a sense. I became less restless and didn't always have to be on the go. In terms of my attitude, it helped me become more tolerable, where otherwise I may have become angry more easily." Several participants mentioned specific substances they used to help manage their symptoms. Specifically, two participants mentioned using marijuana saying, "Marijuana helps calm my

nerves. I would be more relaxed, helps me be less impulsive," and "I think using marijuana helped manage my symptoms, but I don't think other drug use made a difference." Others mentioned that they used alcohol or opioids to manage their symptoms, and reported that they "felt opioids helped me concentrate better," and that when they used "heroin and opiates, [they were] more motivated to get things done, and was more aware of things." Another indicated that although their symptoms improved, there were unintended consequences, reporting "opiated helped concentration, but got to the point I looked for them all day so I wouldn't run out. I wasn't getting anything accomplished." Another participant mentioned that "drugs seemed to help with symptoms. Specifically the depressants, alcohol and opioids helped calm me down and lessen ADHD symptoms. Heroin did what I needed it to—it curbed my overthinking, my anger, and made me less depressed, allowed me to work and focus on what I needed to do."

Three of the participants reported that their attentional symptoms worsened with the use of drugs. They reported that when using, they had "difficulty concentrating," "procrastinated more and had more difficulty completing tasks," and that "when high I became more impulsive." Two participants indicated that they believed there was no impact of their substance use on their attentional symptoms.

Question 3. Participants were asked if they believed that their difficulties with attention have influenced their efforts at recovery from alcohol and other drugs. Two of the participants felt that their difficulties with attention did not influence them significantly, if at all, one mentioning that they "have to read stuff over and over, but that's okay." However, the remainder of participants (84.6%) mentioned that their difficulties with attention influence their efforts towards recovery in a multitude of ways, both short-term and long-term.

Several participants mentioned symptoms of ADHD negatively impacting their ability to attend and participate in groups and other recovery related activities, such as having "trouble remembering appointments, and I forget to do things," and reporting "difficulty going to groups because I am late or don't show up." Several participants mentioned underlying self-medication of symptoms hindering recovery efforts, one participant mentioned that "this is the first time I've sought treatment for ADHD symptoms from the doctors, every other time I was self-medicating." "So my recovery was unstable and unsustainable because I kept going back to heroin to manage my symptoms." Another mentioned that "…using alcohol, marijuana, and heroin seemed to calm me down. Those have been my coping skills for years, and it's hard to change the habit."

Another theme participants discussed was the influence of their attentional symptoms on their ability to achieve a long-term goal such as recovery from substance abuse. They reported frustration and fear that they "wouldn't succeed" and that they felt that because of their symptoms they "didn't want to try, no point in continuing." Additionally, they mentioned that "attention difficulties inhibit recovery. Concentrating, forming, and sticking to plans was difficult." One participant mentioned that because of their symptoms, they felt they were "all over the place," and have a "hard time putting forth all effort toward goals." There is a "lack of focus and discipline and I don't feel like I have the ability and something will always be wrong with me." Another cited impatience and frustration playing a role in relapses, specifically, "frustration lead to relapses… hard to keep clean because of impatience."

Question 4. Participants were asked how they felt their difficulties with attention have affected their progress in treatment and getting the most out of treatment. Almost all of the participants (92.3%) cited specific attentional symptoms or the importance of personal

motivation to stay focused in treatment on a day to day basis, as well as working towards a long-term goal. Eight of the participants specifically reported difficulty with paying attention during groups and difficulties with "daydreaming,' "staying focused," or "get bored and distracted easily." One mentioned that "It's really hard to keep on task during group. We got off easily onto tangents... It's hard to be in the now—when in group, [I'm] thinking about break. When on break, [I'm] thinking about group." They also reported problems with comprehension due to inattention, such as "I do not comprehend info told to me, and I tire easily of hearing the same things."

Symptoms of restlessness, inattention, and impulsivity were also related to difficulties with staying in treatment long term. As one participant reported, difficulties with attention have "made me relapse a lot, and not take treatment as seriously as I should." Other participants expressed similar sentiments, including "impulsivity, restlessness influence ability to stay in treatment through completion," and "If something is not fun or enjoyable, I move on to feed the void." Several participants highlighted the importance of personal motivation to be successful in treatment, saying "they have to want it first. Everyone goes through recovery differently," and highlighting the skills necessary to succeed long term, "have to devote your time and attention to stay in treatment and meet goal."

Question 5. When asked how alcohol and drug treatment could better help individuals with co-occurring attention problems, many participants gave insightful answers on how treatment centers could better help address attentional challenges that influence substance use and recovery efforts including prescreening, medication, and external motivators. Several participants mentioned the utility of pre-screening for attention problems and following up with the results, in order to more fully address these concerns in treatment. One participant mentioned

that they had gained insight into their symptoms through the research process, and that they "never thought it was that bad, I should talk to someone about [my] ADHD." Another reported that they "believe if ADHD is treated, it would decrease the urge to use substances."

Several participants noted the role of medication in treatment of ADHD symptoms. However, an expressed concern was that their physician would not prescribe medications for their attentional symptoms due to their history of substance abuse. One mentioned that "taking ADHD meds would help, but [I have a] hard time talking to my doctor because [stimulant medication is] a controlled substance that's abused." Another highlighted the importance of medication in treatment saying, "First, you gotta get the medication right. I've tried different things, and none of them worked. Also, being labeled "addicts," it's hard to talk to the doctor because they think you are pill seeking. It's a tough situation to be able to talk to the doctors about what we need, because sometimes we do know what works, but they don't want to give it to us." One reported that although they have a previous diagnosis of ADHD, they have had difficulty getting medication to treat their symptoms due to their substance use history, "[my] new doctor said they won't prescribe stimulants to substance abusers."

Finally, participants mentioned structure and external motivators can often be beneficial in treatment. Several mentioned the importance of addressing the comorbid diagnosis through groups specifically aimed at helping comorbid ADHD and substance use, teaching coping skills and "helping them organize their treatment and stay on top of it." Another mentioned the importance of being sensitive to those with ADHD within groups, and the importance of taking breaks to allow time to refocus, particularly during longer groups. Others mentioned the utility of external motivators such as "being on contracts for clean drug screens and keeping all

appointments." One mentioned that they needed even stronger external motivators, such as "being forced to be in treatment helps, wouldn't commit otherwise."

CHAPTER 5: DISCUSSION

Major Findings

The argument presented in this thesis has been that although studies of ADHD within substance abuse populations have indicated a prevalence of approximately 20%, (van Emmerik-van Oortmerssen et al., 2012), relatively little research has been conducted to flush out the differences between those with ADHD and those without ADHD in substance use treatment programs. It was argued that this work is important because such differences would have implications for understanding the development of addictive behavior problems among those with ADHD and improving treatment in this subpopulation of individuals with substance use disorders (Arias et al., 2008; Faraone, Wilens, Petty, Antshel, Spencer, & Biederman, 2007; Wilens, 2004b).

The major finding from this study was that substance use patients with a history and current ADHD symptomology are indeed a separate population with documented clinical differences. The use of the Wender and brief ASRS was effective in identifying participants meeting research criteria for ADHD as confirmed by the CIDI interview. Moreover even with a very small sample size, they were clearly separable not only in terms of reported difficulties in attention but by both their history of conduct disorder problems in childhood and the level and severity of current executive functioning deficits. There were also some documented differences in substance use history including age of onset of initial drug use and number of drugs abused. It was more difficult to show any differences in motives for substance use and the impact on treatment and recovery efforts.

This discussion section will review the major study findings by research question and then discuss study limitations, and clinical and research implications of this work. Areas of

agreement with the existing literature reviewed above will be highlighted and any inconsistencies also noted. The qualitative findings from the comments of ADHD participants are integrated throughout and discussed in the relevant section (e.g., effect of use on their ADHD with substance use motives, impact on treatment under treatment section).

Study Plan and Final Sample

The primary goal of this study was to further expand the literature on co-occurring ADHD and Substance Abuse Disorders by examining potential differences in substance use history and treatment variables, reported motives for using various substances, and differences in executive functioning between a comorbid and substance abuse comparison group. Working with the staff at PORT Human Services outpatient substance abuse treatment program, we were able to screen and identify 13 individuals with co-occurring ADHD and substance abuse and a comparison group composed of 10 individuals in treatment for substance use without this comorbidity over a period of three months.

A total of 37 potential participants were screened for inclusion in the study. Beyond the final 23 participants included, there were 14 more screened who either did not meet qualifications for the study, or did not complete additional measures beyond the prescreening instrument. It appears that the use of the Wender and ASRS was effective in identifying participants with both current and childhood symptoms, as well as those without any difficulties with attention. Seven of the potential participants were excluded due to meeting the threshold for either childhood, or adulthood symptoms, but not both. This is important; due to the interconnection between substance use and executive functioning, we wanted to ensure that our participants truly had a history of ADHD, and that their symptoms were not a function of their substance use. Unfortunately, there were seven potential participants who qualified for the study, but were

unable to be scheduled for a follow up visit. This is not surprising given the challenges associated with no show rates within outpatient substance use treatment, particularly since many of these potential participants qualified for the ADHD comorbid group.

Analysis of Table 3 clearly showed the effectiveness of the Wender/ASRS as a brief screener, as there were significant differences between the two groups in terms of their scores on both measures. In addition, for those that qualified for the ADHD and substance use comorbid group, there was 100% confirmation of a research diagnosis of ADHD using CIDI ADHD module. In fact, of the 13 participants, nine reported receiving a diagnosis of ADHD in the past, which is higher than expected based on previous research that suggested that many of the participants who screened positive for ADHD had not received a diagnosis (Kessler et al., 2006), but this may be due to self-selection bias. Eight of the thirteen had been prescribed stimulant medication for ADHD in the past, but based on the questionnaire, it was unclear if they are currently taking medication to treat their ADHD symptoms, or this was primarily during childhood. One of the participants even reported that they had been prescribed medication, but had never taken them.

ADHD and Conduct Disorder

One challenge associated with conducting research in a substance use population with possible ADHD is the high comorbidity of conduct disorder with both ADHD and substance use. The literature is mixed regarding the specific independent contribution of ADHD to substance use disorders—some report that the effects of ADHD are not as significant when controlling for CD (Flory & Lynam, 2003; Torok, Darke, & Kaye, 2012), others suggest that CD might be a mediating factor between ADHD and SUD (Mirza & Bukstein, 2011), while others propose that ADHD is an independent predictor of substance use disorders (Elkins, McGue, & Iacono, 2007;

Wilens et al., 2011). It is precisely because of the challenges disentangling the individual effects of substance use, ADHD, and conduct disorder that we wanted to be able to assess and control for any possible effects of conduct disorder. While we did not test for the specific relationship between SUD, ADHD, and CD, we did find that the ADHD group had significantly more problems with conduct behaviors during childhood and adolescence. The most frequently reported conduct problems during childhood and adolescence were: stealing or shoplifting /forging signatures, and running away or staying away overnight, which were reported by both groups. In addition, staying out after curfew, and starting fights were also commonly endorsed but only in the ADHD group.

Given these differences between the groups, we statistically examined whether variables contributed to classification beyond conduct disorder in regressions. We found that the presence of conduct disorder may predict a large amount of the variance between the groups, but is not the only variable that can reliably distinguish the two groups. Based on these results, it is clear that regardless of the specific role conduct disorder plays when combined with ADHD and substance use disorders, it is important to address conduct problems in addition to ADHD while in treatment for substance use disorders. Past research has suggested that patients with the additional co-occurring diagnosis of conduct disorder along with ADHD have been found to have the poorest outcomes in terms of their long-term course of substance abuse (Wilens et al., 2011). Future research will need to disentangle the specific differences between these groups, in order to allow for the development of targeted treatment plans.

Substance Use History

Based on a review of previous literature conducted in the area of substance use history, we hypothesized that individuals with comorbid ADHD would differ from those with only

substance use disorders in several ways. Specifically we hypothesized that those with ADHD would use of more substances overall, both licit (including nicotine), and illicit (including stimulants), initiate alcohol and other drug use at an earlier age, and have problems with alcohol earlier and for a longer period of time. While we found that those with ADHD did have a different substance profile including the use of more substances and initiation of these substances at an earlier age, and also used alcohol for a longer period of time, we did not find any significant differences between the groups in terms of the duration of their problems.

Lifetime types of drugs used. In terms of different substances that each group reported using at least once throughout their lifetime, we found that the groups significantly differed on the use of stimulant use, both illicit use of cocaine and meth as well as non-prescription stimulants such as Ritalin. The groups did not differ on their use of alcohol, nicotine, or marijuana, but the ADHD group reported using other illicit drugs including benzodiazepines, opiates, inhalants, and hallucinogens. This fits our hypothesis that those with ADHD will have used more illicit substances than the comorbid group, but there was not a significant difference between the two groups in terms of their use of licit substances (e.g. alcohol or nicotine). This makes sense given that previous literature in this area that suggests that subjects 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 (Molina & Pelham, 2003).

Total number of substances and primary drug of choice. Given the wider variety of substances tried in the ADHD group, it makes sense that the total number of substances used by the ADHD group would be significantly higher than the total number of substances used by the substance use only group. When asked about their primary drug of choice, it was somewhat

surprising that none of the participants in the ADHD group indicated the preference for stimulants, but the majority reported preferring to use opiates. This finding was particularly interesting given the differences in use motives for different drugs, and the varied motives participants in the ADHD group reported for use of opiates.

Age of onset of substance use. When the groups were compared on use of individual substances, the most significant findings related to the age of first consumption of alcohol, nicotine, and marijuana. Specifically, as we hypothesized, those in the ADHD group were significantly more likely to start using these substances at an earlier age and for a longer period of time than their counterparts in the substance use only group, and on average reported starting to use all three of these substance before the age of 14, and endorsed a significant difference in terms of length of time they had been using alcohol—over 11 years as compared to 5 years in the substance use only group.

These results are consistent with the literature that suggests that those with ADHD have an earlier age of first substance use (Arias et al., 2008), particularly alcohol (Schubiner et al., 2000). This is important, as research suggests that those who start drinking before age 14 are more likely to develop alcohol dependence when compared to those that start drinking at age 21 (Hingson et al., 2006), and adolescents who have problematic use of alcohol are more likely to develop alcohol dependence and other substance use disorders (Rohde et al., 2001). This is also interesting given that our participants reported using alcohol for a significantly longer time than their counterparts without ADHD.

One study that looked at patients addicted to multiple substances found that those with ADHD had a significantly lower age of first consumption of marijuana, amphetamines, cocaine, and heroin compared to those without ADHD (Ohlemeier et al., 2008). Our findings for age of

consumption of different substances were similar, with those with comorbid ADHD having a significantly younger age of use of alcohol, nicotine, and marijuana. However, we did not find statistically significant results for age of first use of cocaine and heroin.

Substance variables summary. In order to test the hypothesis that substance use variables could reliably distinguish between the ADHD group and substance use only group, we entered the substance use variables found to have the most significant effects into a logistic regression analysis. While none of the variables on their own was found to be have significant partial effects in this analysis, as a whole, these variables were able to explain between 74-100% of the variance in group classification, and correctly classified 100% of cases, suggesting that these variables can reliably differentiate the groups. Based on the odds ratios, the strongest predictors of ADHD classification were the age of first use of marijuana and nicotine, along with the use of non-prescription stimulant medication. It is somewhat surprising given previous literature that age of first use of marijuana and nicotine emerged among the strongest predictors, but not the age of first use of alcohol. Future research may want to include age of initiation of nicotine and marijuana in addition to alcohol in future analysis.

Motives for Substance Use

Research suggests that expectancies and motives are central to alcohol and other drug use, and some motives are associated with poorer outcomes (Cooper, 1994; Cox & Klinger, 1988; Doyle, Donovan & Simpson, 2011; Kuntsche, Knibbe, Gmel, & Engels, 2005); therefore, it is important to understand and address motives for use in treatment (Doyle et al., 2011). We hypothesized that those with comorbid ADHD would have a different profile for use of alcohol, and other drugs, specifically we hypothesized that they would report using these substances for coping motives, especially to achieve “mental” effects. Unfortunately, not enough of the

substance use only group had utilized stimulants or opioids to compare the two groups on these substances, so we were only able to compare the ADHD and substance use only group on their alcohol expectancies. However, we were able to compare the ADHD group on the different motives for use they reported for each substance—alcohol, stimulants, and opioids.

Contrary to our hypothesis, a comparison of the two groups on their motives for use of alcohol yielded no significant differences between the groups. These non-significant results could be due to the small sample size, the large differences in the standard deviation, or a nonsignificant effect. They could also be due to the fact than not all of the participants felt that they abused alcohol, or the fact that none of the participants indicated that alcohol was their primary substance of choice.

Although not significantly different between groups as predicted, coping was the highest motive endorsed by both groups. Other scales that were elevated corroborate research done by Hides (2008) which examined substance use motives in young adults seeking mental health treatment. They found that individual subscales including positive and negative drug effects, social reasons, and coping are the most common reasons for use (Hides, 2008). Coping motives for use may be particularly problematic in this population, as these prior findings suggested for those with current substance use disorders, using substances for coping and drug effects were related to more severe symptoms and lower levels of functioning (Hides et al., 2008). While we expected the ADHD group to endorse more use of alcohol for coping motives, both groups may be using alcohol to cope with various stressors, perhaps not just symptoms of attention as initially hypothesized. Interestingly, using alcohol for "mental effects" was the lowest individual motive endorsed for both groups, which is contrary to our hypothesis. This may be due to the ADHD group possibly using other substances (such as stimulants or opioids) for mental effects,

as alcohol was significantly lower than the use of stimulants or opioids when comparing mental effects across the ADHD group.

In the ADHD literature, the primary focus in terms of motives for use or expectancies has been on self-medication as a type of coping motive (Blume, Marlatt, & Schmaling, 2000; Wilens; 2004). The "self-medication hypothesis" was originally based on the work of Khantzian (1997), suggesting that those with psychiatric disorders, including ADHD, report choosing specific substances for their compensatory actions, such as those with ADHD symptoms choosing amphetamines due to their stimulating properties. However, within the general substance use disorders literature, the "self-medication hypothesis" provides conflicting results, as certain substances may worsen symptoms, rather than provide relief. When the participants with ADHD were asked if their use of substances tend to improve, worsen, or have no impact on their ADHD symptoms, the majority reported that their ADHD symptoms were improved by using substances such as marijuana, alcohol, and opioids to help them achieve different effects. None of them mentioned using stimulant medications to achieve these effects, which is contrary to what is widely believed according to the narrow "self-medication hypothesis" for ADHD.

Additionally, when asked if their difficulties with attention have influenced their use of alcohol or other drugs, the majority cited using substances, particularly opioids, to achieve specific effects. Many of these desired effects were directly related to their ADHD symptoms, including helping them concentrate, slow thought processes down, be less restless, and accomplish tasks, suggesting that they used the substances because they believed or expected that they would achieve certain results. Although research suggests that certain substances may worsen psychiatric symptoms, our participants may believe that their symptoms are being lessened by the use of substances—at least initially. Previous literature confirms this

phenomenon, which suggests that perhaps the patient *believes* that substances are, at least intermittently, reducing or alleviating their psychiatric symptoms (Blume et al., 2000).

When the ADHD group was compared on their use of alcohol, stimulants, and opioids for achieving different effects, opioids in general were the highest endorsed substance across multiple motives. Specifically, opioids were reported to be used significantly more than either alcohol or stimulants for all motives other than social facilitation and social subscale. Based on our hypothesis, we expected that the ADHD group would highly endorse coping motives and using substances for mental effects. Although we found the coping subscale to be the highest of the three subscales, particularly for use of opiates, surprisingly use of substances for mental effects within the ADHD group was among the least frequently endorsed motives.

Overall, it appears that participants in the ADHD group had more and varied motives for using opiates than either alcohol or stimulants. This may be related to the higher percentage of the ADHD group who endorsed opiates as their primary drug of choice, or the possible belief that opiates can help manage their symptoms. It is also likely that as severity of drug use increases, endorsement of all motives across the board may increase. Although we did not attempt to classify participants' drug use on the basis of severity, it could be that that the endorsement of more motives for opiates reflects greater severity. Regardless, there is a lack of research on the use of opioids by those with ADHD, as most research has assumed that stimulants are utilized to manage symptoms. Based on our analysis of the motives for use and the qualitative discussions, it might be beneficial to further research motives for multiple substances and the role they play in "managing" ADHD symptoms.

Differences in Executive Functioning

It has been postulated that the primary deficit in ADHD involves difficulties with executive functioning (Barkley, 1997), as adults with ADHD report difficulties such as "feeling scattered and being chronically late for appointments, anxious, irritable, and overwhelmed with the tasks of daily living" (Elliott, 2002, p. 737).

Although executive functioning deficits are often associated with ADHD, they are also a concern among substance abuse patients. In the field of substance use, there is consistent evidence that various substances have a negative impact on executive functioning such as attention, learning, memory, and visual spatial abilities, and may be strongly associated with impulsivity, working memory, and decision-making (Yücel, Lubman, Solowij, & Brewer, 2007). However, it is unclear which comes first—the preexisting deficits in executive functioning, or the substance use. Research suggests that preexisting deficits in executive functioning may predispose some individuals to substance use disorders, which in turn may exacerbate their deficits in executive functioning (Giancola & Tarter, 1999; Nigg et al., 2004). Thus, looking at the influence of executive functioning deficits in ability to function is doubly important in those with both ADHD and substance abuse. We hypothesized that those with comorbid ADHD would report greater deficits in executive functioning compared to the substance use only group, particularly for the areas of self-management to time and self-activation/concentration.

When comparing those with ADHD and substance abuse to those with substance abuse alone, there were significant differences found between the groups for every subscale on the BDEFS as well as the total score. This was somewhat surprising based on our hypothesis, because the significant differences between the groups occurred in each domain of executive functioning —not just self-management to time and self-concentration. However, this may

reflect less independence of the different aspects of executive functioning and that the BDEFS actually measures one factor, since we found the scales to be highly correlated. The BDEFS total score significantly predicted group membership along with childhood conduct disorder problems.

Although those with ADHD reported more difficulties with executive functioning compared to the substance use only group, it is interesting that the present comorbid ADHD group reported more difficulties with executive functioning across the board than either Barkley's normative ADHD or community sample, and even the substance use only group reported more difficulties with self-organization/problem solving and self-motivation than Barkley's normative community sample. This suggests that there are perhaps additive effects of both ADHD and substance abuse on deficits in executive functioning, above those of ADHD in a normative sample alone. This makes sense given that research has suggested that executive functioning deficits are present in substance abuse populations as well as within ADHD populations. This may also suggest that substance use alone may influence impairments in executive functioning.

Based on the logistic regression examining the influence of the individual BDEFS subscales with and without conduct disorder included, self-restraint/inhibition was the most predictive factor for membership in the ADHD group. Although we had not hypothesized this finding, it makes sense given that inhibition and impulsivity have been associated with other problems such as conduct disorder and substance use disorders (White et al., 1999). Self-management to time was another predictive factor, which we had hypothesized would be an area in which the ADHD group would report more difficulties. These results fit together well with our qualitative findings, based on participants' reflection of how their symptoms have influenced

them in both treatment and recovery as themes of problems with impulsivity, time management, and concentration emerged.

When participants with ADHD were asked how their difficulties with attention have influenced their attempts in treatment and recovery from substances, many noted difficulties associated with executive functioning such missing or forgetting appointments, being late, or difficulties paying attention when they attend group such as daydreaming, getting bored or distracted easily, and not being focused on the group. These symptoms such as restlessness, inattention, and impulsivity were not only reported to be problematic in the short term, but also problematic when trying to achieve longer term goals, such as successful completion of treatment and maintaining abstinence.

Treatment History and Impact on Treatment

It is important to understand how to manage ADHD symptoms in addition to substance use due to the negative impact ADHD may have on the treatment and recovery process of those with ADHD and comorbid substance use disorders (Carroll & Rounsaville, 1993). One step in trying to understand how to best manage symptoms is to understand the patterns related to treatment history. We hypothesized that those with ADHD would report an earlier first age of treatment for substance use disorders with more unsuccessful attempts to quit drinking.

For age of first treatment, our results were not significant between the two groups, but the ADHD group surprisingly had a higher average age of first treatment than the substance use only group, which was contrary to our hypothesis. However, those in the ADHD group reported a larger number of previous treatments for drug use which we had expected, although this number was not significant when compared to the substance use only group. The only significant finding in the treatment variables was the number of times those with ADHD had been to treatment

specifically to detox from drugs. Previous research of cocaine abusers in treatment, those with childhood ADHD were younger at presentation for treatment and reported more severe substance use, as well as more previous treatment/higher rates of relapse after successful treatment (Carroll & Roundsaville, 1993). Although our age of treatment results were the opposite of this study, we did find similar results in terms of more previous treatment attempts in the ADHD group.

When comparing the groups on number of days in treatment, those in the ADHD group had a longer average number of days in treatment, but this result was not statistically significant compared to the substance use only group. This is similar to the results of study that examined the length of stay in a residential treatment center, the mean number of days in treatment was lower in ADHD group, but this result was also not statistically significant (McAweeney et al., 2010).

Previous research all suggests that those with ADHD may struggle with poorer treatment adherence, difficulty with achieving the goals set in treatment, and higher rates of relapse upon leaving substance abuse treatment due to attentional difficulties and poor executive functioning associated with the disorder (Arias et al, 2008; Carroll & Rounseville, 1993; Ohlemeier et al., 2008; & Wise, Cuffe, & Fischer, 2001. Unfortunately, in our sample, we were unable to find any major differences between the two groups in terms of treatment variables. Both groups had similar number of days in treatment, and although the ADHD group had more attempts at treatment for drugs, this result was non-significant except concerning the number of times the ADHD group had attended detox for their drug use.

However, the qualitative interviews did suggest potential impact of ADHD on treatment. Specifically, participants indicated that they had difficulty with inattention, restlessness, and impulsivity which influenced staying on task in groups and maintaining motivation for recovery.

They suggested implementing screenings for ADHD symptoms, addressing symptoms through medication, increased structure, and external motivators would all be helpful for those struggling with ADHD symptoms within treatment for substance abuse. This suggests that treatment may be more difficult for some than others. This may be due to symptoms of ADHD influencing their ability to concentrate and achieve goals when in treatment, and rates of relapse from treatment.

Based on the literature and our results, it is not clear if those with comorbid ADHD have are less successful than their peers in treatment, but it is clear that there is need for further examination of these variables, particularly as they may be related to factors that could influence treatment success such as deficits in executive functioning skills generally as well as how to manage self-restraint/inhibition and self-management to time specifically.

Study Limitations

There are several limitations to this pilot study. The most significant limitation is the small sample size. Although we found some suggestive findings, particularly related to differences between the two groups in age of first use of several substances, it may be that we failed to detect other differences in substance use patterns, and we were unable to examine group differences in motives for different drugs of abuse. Relatedly, we also had some attrition in the screening process. Due to the time constraints of our participants, we chose to proceed with the informed consent and prescreening, and if they qualified for the study we gave the participants the option to complete the remainder of the measures at another time. As a result, we had some potential participants that qualified for the study, but did not complete the remainder of the measures. It is unclear if these potential participants differed from the other participants in key ways such as severity of executive functioning.

Generalizability is of course limited by age and recruiting participants from a specific treatment program within a single community. The stringent inclusion and exclusion criteria, and specifically the need for participants to have 30 days of abstinence before participation, may also limit generalizability, as it is not known if a group that is able to achieve at least 30 days of abstinence time differs from their peers in significant ways. The choice for exclusion of those with less than 30 days of abstinence was to ensure that any symptoms reported (particularly of attention or executive functioning deficits) represented true symptomology rather than effects of the substances themselves. By allowing patients who abused various substances to enroll, we broadened our sample but may have introduced variation due to drug of choice.

One specific limitation to this study was the failure to adequately ask about history of stimulant medication. Based on the questions, we were unable to tease out participants who had been prescribed stimulants in the past, and those who currently had prescriptions for stimulant medications and were taking these medications regularly. This will be an important factor to consider in future research to determine if ADHD had been diagnosed in childhood and a stimulant medication had been prescribed, but never taken, compared to those who were appropriately taking medication for their ADHD symptoms, due to the impact this could have on their ability to succeed in treatment.

Because this was a pilot exploratory study of potential differences we conducted multiple statistical tests without adjusting alpha levels and so some of the significant differences might be due to chance sampling and these findings will need to be replicated. The self-report nature of the instruments could also be considered a limitation. However, all measures were chosen to have good psychometric properties, and in the case of executive functioning may have more sensitivity in capturing difficulties in everyday life (Barkley & Murphy, 2011). Despite

limitations in sample size and measures, the present study was successful in distinguishing a comorbid ADHD subgroup of substance abuse patients who likely have special treatment needs.

Clinical Implications (Including Prevention)

The increased risk for children and adolescents with ADHD to develop substance abuse is significant in terms of both prevention and clinical practice. Due to the literature suggesting that earlier age of initial use of alcohol is associated with poorer outcomes, it is important to assess and intervene earlier with ADHD youth, to prevent those with ADHD symptoms from turning to alcohol or other drugs to manage their symptoms. According to Wilens (2004a), intervening at an earlier stage in the expression of ADHD symptoms, could lead to better long-term outcomes for co-occurring mental health and substance abuse disorders. Based on the interviews of those with comorbid ADHD and substance use disorders currently seeking treatment, it is harder to receive treatment for ADHD symptoms once there is a history of substance abuse. Physicians are less willing to prescribe a stimulant medication that has a high risk for abuse, when the patient has already demonstrated behaviors of abuse.

Thus, several factors are important for prevention and earlier intervention. First, it would be important to engage in psychoeducation about ADHD symptomatology with those who are diagnosed during childhood and adolescence, so that they understand the symptoms of ADHD and how they affect them, and the importance of interventions such as medication and coping strategies. Thus, they will be less likely to turn to substances to mask their symptoms, rather than manage their symptoms through more effective methods. Second, it is clear that screening for ADHD needs to be integrated as a more routine part of the intake process for substance use treatment. Many of the participants who participated had struggled with ADHD symptoms for their entire life, but probably did not understand the “at risk” implications of a childhood

diagnosis. Because the prevalence of ADHD is unusually high within substance abuse treatment facilities, there is a need to screen and identify those with these symptoms, so that the symptoms can be properly addressed and not undermine their efforts at recovery.

Within substance use treatment, there are several things that might help those with comorbid ADHD to be more successful. It is clear from the present study that those with ADHD in addition to substance use disorders struggle more with executive functioning deficits more than those with substance use disorders alone. Based on interviews with participants, it appears that these difficulties with executive functioning manifest in multiple ways that have implications on their ability to commit and ultimately be successful in treatment. Frequently there are specialty groups within substance use treatment centers for comorbid disorders. The addition of a group addressing psychoeducation about ADHD in general, and management of executive functioning symptoms should be beneficial for those struggling with ADHD symptoms. In recent years, there have been CBT evidence-based treatments developed for use with adult ADHD patients, such as Solantos manual specifically geared towards executive functioning deficits within an adult ADHD population (Solanto, 2011). To our knowledge, these CBT treatments have not been used with an ADHD population within a substance use treatment facility. However, these treatment protocols might be beneficial to adapt to a substance use population, in order to address the deficits in executive functioning found in those with comorbid ADHD and substance use. In addition, therapists' awareness of limits of concentration and attention spans within treatment groups emerged as an important issue, as it allowed them to structure sessions or groups in a way to maximize the concentration of the participants through more frequent breaks, or changing activities when they sense participants attention is wandering. Finally, participants noted that while they are building internal motivators to succeed in

treatment, it is sometimes helpful to have external motivators to help keep them from relapsing. These would obviously need to be created on a facility and even individual level in order to be most successful, but may include contingency management based rewards for behaviors such as timeliness, attending groups, and "clean" drug screenings. Contingency management for substance use is an established treatment in substance treatment centers (Stitzer & Petry, 2006) that seems particularly relevant for this sub-population struggling with ADHD in addition to their substance use.

In conclusion, since there appears to be important differences between those with ADHD and those with substance use disorders alone, it is important to address these concerns in multiple ways—through prevention, early detection and intervention, and through considering the development of specialized treatments that target managing ADHD symptoms in addition to substance use.

Future Research Directions

Based on the higher prevalence rates of ADHD within substance use treatment centers, we sought to extend the literature in this area and move beyond a prevalence study to begin to describe the differences between these two groups. Our research found several clear and highly important differences between these two groups, but future research will need to corroborate and extend these findings. While we selected three domains (i.e., substance use patterns, motives for use, and executive functioning) that might have had important differences between these two groups, and particularly might have implications for treatment, these are by no means the only potential differences between these two groups. Future research would do well to continue to refine these differences and uncover other differences between the groups (e.g., reward

sensitivity) that could have important implications in helping those with comorbid ADHD and substance use disorder be successful in recovery efforts.

One area we addressed in order to control for the possible effects was that of conduct disorder. The literature in this area is conflicted on the specific roles and pathways of ADHD, conduct disorder, substance use disorders. Future research is needed to disentangle this highly complex area, as the specific roles each play will be important in future research and designing prevention interventions.

A number of prior studies reviewed in Table 1 have examined differences in substance abuse history associated with comorbid ADHD but most of this research has been conducted in conjunction with prevalence studies. As a result, different substances of abuse and populations enrolled in different treatments programs have been used, and findings have not always been consistent. Although the present study extends this literature, it will be important to more systematically address differences related to substance use variables, and determine which have the most implication in terms of their future effects. Specifically, based on our findings, future researchers may want to include age of initiation of nicotine and marijuana in addition to age of initiation of alcohol in future analyses. Researchers may also want to address the specific types of substances those with ADHD are utilizing, as although stimulant use was one predictor of differences between the groups, it was not reported as the primary drug of choice for any the ADHD group members.

The present study also has research implications for studying motives for use. The self-medication hypothesis for ADHD has traditionally assumed that those with ADHD would use stimulants to manage their ADHD symptoms. However, our results suggest that our participants may choose a variety of drugs, including opiates, to manage or escape their symptoms. Further,

aside from the discussion of self-medication in the comorbid ADHD and substance abuse literature, the author could not find any studies empirically examining other motives for drinking or substance use within an ADHD population. It is clear that more research needs to be conducted in this area, specifically looking at coping motives, and different substances beyond stimulants, including opioids. Although the results between the two groups for motives for using alcohol were not significant, it is important to continue studies in this area given our small and particular sample. Studying motives for drug use with an ADHD population and changes in motives over time continues to be an important area for future research, particularly given that those with ADHD tend to use a greater variety of substances than their counterparts without ADHD symptoms. Understanding their expectancies for using more and varied substances may be an important factor that could have significant implications in terms of treatment.

Finally, more robust, longitudinal research is needed into executive functioning among ADHD individuals and the relationship of executive functioning to substance use. Such research might determine the degree to which specific executive functioning deficits (e.g., impulsivity or response inhibition) are predictive of developing substance use problems (Giancola & Tarter, 1999) and also which areas of executive functioning might be exacerbated by patient substance use. Future research should also include some performance based measures of executive functioning, as they can be helpful in determining specific deficits in executive functioning (Kamradt, Ullsperger, & Nikolas, 2014). As Kamradt discussed, more research is needed that concurrently looks at both types of executive functioning measures—self-report assessments and performance based measures. This would not only add to our understanding of the symptoms and impairments of those with ADHD (Kamradt et al., 2014) but also could add to our

knowledge around the differences between those with ADHD and substance use disorders versus those with substance use disorders alone.

Based on the highly significant differences found not only between our comorbid group and substance use only group, but also Barkley's ADHD group, it is clear that future research studies should explore the differences between those with comorbid ADHD and substance use, substance use alone, and ADHD alone in terms of their executive functioning deficits. Prospective research might clarify how such deficits and possible moderator variables affect important life outcomes including substance use. Lastly, as discussed above, applied research on how targeting such deficits in comorbid ADHD patients with substance abuse difficulties might enhance treatment is also need.

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APPENDIX A: IRB DOCUMENTATION

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/irb**

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB

To: Marina Stanton

CC: Tony Cellucci
Marina Stanton

Date: 2/24/2014

Re: UMCIRB 13-002638
Co-occurring ADHD and Substance Abuse: Substance Use Patterns, Motives and Executive Functioning

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 2/24/2014 to 2/23/2015. 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
1- ADHD prescreening with WURS-Short and ASRS.docx	Surveys and Questionnaires
2- Demographic form.docx	Surveys and Questionnaires
3a- Drug History & Treatment History Questions V3.doc	Surveys and Questionnaires
3b- Conduct Problems.doc	Surveys and Questionnaires
4- Desired Effects Scale w stimulants and opioids (1).docx	Surveys and Questionnaires
5- BDEFS-LF.doc	Surveys and Questionnaires
6- CIDI_ADHD module	Surveys and Questionnaires
Deidentified gift card distribution log	Additional Items
Drug History Cards for sorting	Surveys and Questionnaires
Individual gift card distribution log	Additional Items
Informed consent version 2/4/14	Consent Forms
Master list of participants	Additional Items
Master list of participants (de-identified)	Additional Items
Qualitative Questions for comorbid ADHD and SUD group	Interview/Focus Group Scripts/Questions
Recruitment Flyer for PORT	Recruitment Documents/Scripts
Thesis proposal for Co-occurring ADHD and Substance Abuse: Substance Use Matters, Motives and Executive Functioning	Study Protocol or Grant Application
Thesis protocol instruction sheet	Surveys and Questionnaires

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

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

East Carolina University

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Co-occurring ADHD and Substance Abuse: Substance Use Patterns, Motives and Executive Functioning
Principal Investigator: Marina Stanton, MS
Institution/Department or Division: East Carolina University Psychology Department
Address: 312 RAWL Building, Greenville, NC 27858
Telephone #: 252-737-4180

Study Sponsor/Funding Source: ECU Psychological Assessment and Specialty Services Clinic

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Researchers within East Carolina University (ECU) psychology department study problems in society, health issues including substance abuse, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of individuals who may have behavioral health challenges. To do this, we need the help of volunteers who are willing to take part in research. We are partnering with PORT Human Services because they are the main provider of substance abuse services in the region.

Why is this research being done?

The purpose of this research is to better describe any differences or needs of people with attention difficulties vs. those who do not, within a treatment center for substance use disorders. The decision to take part in this research is yours to make. By conducting this research, we hope to learn if there are differences between those who struggle with comorbid attentional difficulties in terms of patterns of use (including substances used and treatment history), motives for use, and ability to plan, prioritize, and pursue goals.

Why am I being invited to take part in this research?

You are being invited to take part in this research because you are a young adult (between 18-35 years of age), and receiving help for substance use problems at PORT Human services. If you volunteer to take part in this research, you will be one of about 40 people to do so.

Are there reasons I should not take part in this research?

You understand that you should not volunteer for this study if you are under 18 years of age, or older than 35 years of age, or have a history of a Traumatic Brain Injury. In addition, you understand that you should not volunteer for this study if you have used alcohol or other drugs in the past 30 days, or are experiencing any withdrawal symptoms because these might influence the measures used in this study.

What other choices do I have if I do not take part in this research?

You can choose not to participate. This decision will not affect the services you are already receiving at PORT Human Services in any way, either now or in the future, nor will they affect in any way any future interest in ECU.

Where is the research going to take place and how long will it last?
The research procedures will be conducted at PORT Human Services outpatient clinic, and will consist of one research session. The total amount of time you will be asked to volunteer for this study is one session estimated to last between sixty minutes to one and a half hours (estimated time to be 60 minutes).

What will I be asked to do?
You are being asked to do the following: You will complete pre-screening questionnaires regarding difficulties with attention during childhood, and over the past 6 months. This measure should take between 3-7 minutes to complete. Based on the results of your pre-screening and our current study sample, you may be invited to continue with the research whether or not you have difficulties with attention.

If you are invited to continue with the research, you will be asked to fill out additional questionnaires and interviews, which are expected to take approximately one hour.

Interviews:
A trained research team member will ask you questions about your substance use and treatment history. In addition, you may be asked questions about possible attentional difficulties, and how these influence your use of alcohol and/or other drugs, or your efforts at recovery.

Questionnaires:
Along with, and embedded within the interview, you will be asked to fill out several questionnaires that ask you to report on demographics, including any difficulties you had with conduct problems in childhood/ adolescence, desired effects you have wanted from drinking or use of other drugs, and problems you may have with time management, motivation, self-organization, self-restraint and regulation of emotions.

What possible harms or discomforts might I experience if I take part in the research?
While we believe that this is a minimal risk of harm study, there are always some risks (the chance of harm) when taking part in any research. Discussing psychosocial and/or health related topics, including alcohol and or other drug use, may be distressing for you. In order to try and minimize any potential risks, you do not have to answer any question you do not wish to answer, and most participants actually benefit from telling their story to a concerned listener who is encouraging them in their efforts toward recovery. If you become distressed during the course of the study, we will stop the study assessment immediately. Further, we will seek information about whether you could benefit from additional support from your clinician or psychiatrist at PORT Human Services. We will determine who may be the best/most immediate person at PORT to follow-up with you in order to reduce any distress and eliminate any risk of harm.

Your participation and the interview/ questionnaire data you provide will be considered confidential. There is one exception or limit to confidentiality, if you disclose abuse or neglect of a child or vulnerable adult, or verbalize an immediate risk of harm to self or others, we are mandated to report this, but will discuss this with you before moving forward with reporting.

What are the possible benefits I may experience from taking part in this research?
We believe that there are both direct and indirect benefits of participating in the present study. With regard to direct benefits, people often report talking about their recovery and factors that make abstinence a challenge is beneficial for people. With regard to indirect benefits, this research might help us learn more about how to help those with attentional difficulties be more successful in their efforts at recovery from substance use disorders. Moreover, after the study has been completed, general study aggregated results will be shared with staff at PORT Human services in order to help them understand the needs of

patients with attention difficulties, and any possible interventions that could be helpful to their treatment. Finally, a 1-page summary of the findings of the study will be made available at PORT Human services to all patients or staff at PORT interested in these results.

Will I be paid for taking part in this research?

If you are selected to participate after the prescreening questionnaire is completed, you will be given a small token of appreciation for the time you volunteered. All participants who complete the interview and questionnaires will receive a $10 Walmart gift card, regardless of your completion of these measures.

What will it cost me to take part in this research?

It will not cost you any money to be part of the research, although you are donating your time.

Who will know that I took part in this research and learn personal information about me?

To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- ECU Psychology research team
- Port Human Services staff members, who will either tell you about the opportunity, or who have responsibility for overseeing your welfare during this research should you become distressed. In addition, a copy of this informed consent will be provided to PORT, and placed in your file. PORT staff will NOT be informed of any other information about you, unless you specifically request information to be reported to your counselor. The only instances that we would have a duty to report (limit to confidentiality above) if you were to disclose information that puts either you or others at potential risk.
- Any agency of the federal, state, or local government that regulates human research. This includes the Department of Health and Human Services (DHHS), the North Carolina Department of Health, and the Office for Human Research Protections.
- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.

How will you keep the information you collect about me secure? How long will you keep it?

Any information that is obtained in connection with this study will remain confidential, and will only be known to the study investigators, and will be disclosed only with your permission. The only place your name will appear is on this informed consent and on the individual page of the $10 gift card log kept by the researchers; otherwise a numerical code will be used. No names or other personally identifying information will be included in any analysis or reports that result from this study. All data files and questionnaires will be kept securely locked within the ECU psychology department lab and will be destroyed seven years following the study. An electronic database with all participants' information will be kept confidential on a secure Pirate Drive, but will not contain any identifiable information other than a pre-determined participation identification number.

What if I decide I do not want to continue in this research?

If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping. If you have already completed the pre-screen and started with additional questionnaires or interviews, you will not lose any benefits that you should normally receive.

Who should I contact if I have questions?

The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Mrs. Marina Stanton, at 252-702-5044 (days, between 9:00-5:00), or the Faculty Supervisor, Dr. Tony Cellucci, at 252-737-4180 (days between 10:00-5:00).

If you have questions about your rights as someone taking part in research, you may call the Office for Human Research Integrity (OHRI) at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of the OHRI, at 252-744-1971.

I have decided I want to take part in this research. What should I do now?

The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

_____ _____

Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

_____

Person Obtaining Consent (PRINT) **Signature** **Date**

_____

Principal Investigator (PRINT) **Signature** **Date**
(If other than person obtaining informed consent)

APPENDIX B: MEASURES

Demographics

1. Age:_____

2. Gender:_____

3. What is your current marital/romantic relationship status?

____Single ____Separated

____Married ____Divorced

____Widowed ____Cohabitating

3a. If single, are you currently in a relationship?

____Yes, dating a single person exclusively (boyfriend/girlfriend)

____Yes, dating multiple people

____No

4. Ethnicity: (check only one)
____African American ____Caucasian/ European American

____Asian American ____Native American

____Hispanic American ____Other: _____

____Multiracial:_____

5. How many years of education have you completed? _____

6. What is the highest level of education you have completed?
___ Less than 4th grade ___ High school graduate (or GED)

___ 5th-8th grade ___ Some college (no degree)

___ 9th grade ___ Associates degree (2 years)

___10th grade ___ Bachelor's degree

___ 11th grade ___ Graduate degree

___ Training or technical education:_____

7. Have you ever repeated a grade, or been held back? ____ Yes _____No
If yes, how many times, and for what grade(s)?
_____

8. Were you ever been suspended or expelled from school? _____ Yes _____No

9. What is your current employment status? (Mark all that apply)
___ Full time (35+ hours) ____ Unpaid service/volunteer

___ Part time (regular hours) ____ Retired/disability

___ Part time (irregular hours) ____Unemployed

_____Other:_____

10. What is your current education status?

___ Part time student ___ Full time student (9+ credit hours)

___ Not currently attending school

11. What has been your *usual* employment status over the past three years? (Mark all that apply)
___ Full time (35+ hours) ____ Unpaid service/volunteer

___ Part time (regular hours) ____ Retired/disability

___ Part time (irregular hours) ____ Unemployed

___Other:_____

12. What has been your usual education status over the past three years?
___ Part time student ____ Full time student (9+ credit hours)
___ Not applicable

13. How many jobs have you held over the past three years? _____

14. Have you ever been diagnosed with a traumatic brain injury? ____Yes _____No

15. Have you ever been diagnosed with a mood or attention disorder (such as Depression, Anxiety, or ADHD/ADD)? ____Yes ____No

If you checked Yes to the question above, what was (were) your diagnosis(es)?

_____

16. Have you ever taken medication for a mood or attention disorder?
____Yes ____No

If you checked Yes to the question above, what medication(s) did you take?

_____

Treatment history:

1) How old were you the first time you ever sought professional help (including Alcoholics Anonymous/Narcotics Anonymous) for help with your drinking or other drug use?
AGE _____

2) How many times in your life have you been treated for alcohol or other drug use? (Include separate treatment episodes including current treatment) (Include detoxification, halfway houses, in/outpatient counseling, and AA or NA (if 3+ meetings within one month period):

a) Alcohol abuse? _____
b) Drug abuse? _____

3) How many of these were detox only:

a) Alcohol? _____
b) Drugs? _____

4) Were you ever mandated to seek treatment by a court or probation? Y/N Number of times_____

5) What is the longest period of time (e.g., days or months), you have stayed enrolled/ active in a treatment program? _____

6) What is the longest time period since started drinking you were *completely* abstinent *in your life* (approximately) (e.g., X days, months, or year(s)? _____

7) What is the longest time period since started using other drugs you were *completely* drug-free (abstinent) *in your life* (approximately) (e.g., X days, months, or year(s)? _____

8) Within the past 6 months (180 days), How long have you been *completely* abstinent from using alcohol? (approximately)_____

9) Within the past 6 months (180 days), How long have you been *completely* abstinent from using any drugs (besides alcohol)? (approximately)_____

Qualitative Questions for Co-occurring ADHD and Substance Abuse Group:

Prior to ending, I would like to ask you a couple of open-ended questions and give you an opportunity to say anything you want to add to this research.

1. We have been talking about your problems with attention and possible ADHD through your life. How do you think your difficulties with attention have influenced you use of alcohol and/or other drugs?

2. Do you think your drinking (or any other drug use) improved, worsened, or had no impact on your ADHD symptoms? Explain

3. How do you think your difficulties with attention have influenced your efforts at recovery from alcohol and other drugs?

4. We are interested in making recommendations to help people with ADHD who are in treatment for substance use disorders. In what ways do you think your difficulties with attention have affected your progress in substance abuse treatment and getting the most out of the treatment?

5. How could alcohol and/or other drug treatment better help individuals with co-occurring attention problems?

6. Any additional comments or ideas?