

## ABSTRACT

Title of Document: RISKY BEHAVIOR IN COLLEGE STUDENTS WITH ADHD

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Individuals with attention-deficit/hyperactivity disorder (ADHD) are more likely to engage in risky behavior across the lifespan than those without ADHD. College represents an important developmental phase during which the initiation and escalation of heavy drinking set the stage for lifelong difficulties with alcohol and other drugs (Maggs, 1997). The present study examined patterns of alcohol use, illicit drug use, risky sexual behavior, and risky driving behaviors among 39 college students with ADHD and 60 college students without ADHD. Results suggested that among college students, ADHD, CD, and their comorbidity were differentially associated with patterns of risky behavior. Results from the present study largely support the overarching view that individuals with ADHD engage in higher rates of risky behavior; however, specific findings were at times inconsistent with the existing literature on young adults with ADHD. Further research is needed to examine moderators of the association between ADHD and risky behavior.

RISKY BEHAVIOR IN COLLEGE STUDENTS WITH ADHD

By

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## *Introduction*

Individuals with attention deficit/hyperactivity disorder (ADHD), and those with comorbid conduct disorder (ADHD+CD) in particular, are more likely to engage in risky behavior across the lifespan than those without these disorders (Barkley, 2002; Barkley, Fischer, Smallish, & Fletcher, 2004; Barkley, Guevremont, Anastopoulos, DuPaul, & Shelton, 1993; Flory, Molina, Pelham, Gnagy, & Smith, 2006; Lahey, et al., 2004; Molina & Pelham, 2003). While the manifestation of risky behavior changes over the course of development, the underlying tendency remains constant. Developmental transitions, such as the transition from adolescence to young adulthood that occurs in the context of the college environment, may permanently alter an individual's ongoing trajectory of health and well-being (Schulenberg & Maggs, 2001). It is during this developmental phase that heavy alcohol consumption, illicit substance use, and risky sexual behavior peak in normative samples (Schulenberg & Maggs, 2001). As we argue below, the propensity for risky behavior associated with ADHD, combined with the health risks faced by college students as a whole, may make college students with ADHD an especially high risk group.

The college years represent an important developmental phase during which the initiation and escalation of heavy drinking set the stage for lifelong difficulties with alcohol and other drugs (Maggs, 1997). Alcohol and drug use during this period can be dangerous in and of itself (Hinshaw, 1992), and can lead to other risky behaviors (e.g., unprotected sex). High rates of heavy drinking and associated risky behaviors among college students (Maggs, 1997) may exacerbate problems for young adults with psychopathology. Individuals with ADHD represent one such vulnerable group. Yet, the

extent of substance use and associated risky behaviors among college students with ADHD remains unknown.

ADHD is a chronic disorder beginning in early childhood that is characterized by developmentally-inappropriate levels of inattention, impulsivity, and hyperactivity (APA, 2000). The behavior of children, adolescents, and adults with ADHD is associated with impairment across a number of domains, including social and academic functioning (Barkley, 2003). Additionally, 40-50% of adolescents (Barkley, 1998; Lahey, McBurnett, & Loeber, 2000) and up to 26% of adults (Barkley, et al., 2004; Mannuzza & Klein, 1999) with ADHD have comorbid conduct disorder (CD), which contributes incrementally to risky behavior (Barkley, 1991; Molina, Smith, & Pelham, 1999). Indeed, the most extreme levels of alcohol use, substance use, and risky sexual behavior have been found among adolescents and young adults with ADHD and comorbid CD (ADHD+CD) (Flory, et al., 2006; Molina & Pelham, 2003; Molina, et al., 1999). To date, no studies have directly explored underlying mechanisms that may explain why individuals with ADHD+CD are most at risk for substance abuse and risky sexual behavior. As Flory & Lynam (2003) suggest, when exploring underlying mechanisms it may be useful to borrow from theories that have attempted to explain why individuals with ADHD+CD are at greater risk for other negative outcomes than those with either disorder alone. Research has documented unique inhibitory problems among those with ADHD+CD (Lynam, 1998), as well as the important role of impulsivity in the development of substance use problems and risky sexual behavior (Brown, Danovsky, Lourie, DiClemente, & Poton, 1997). In addition, higher rates of peer rejection (Miller-

Johnson, Coie, Maumary-Gremaud, & Bierman, 2002) within this comorbid population may be another potential mediating factor.

In individuals with ADHD and ADHD+CD, executive functioning deficits (Barkley, 1997; Nigg, 2001) may be associated with engagement in risky behavior across the lifespan. These deficits include difficulties with impulse control, planning, and working memory (Barkley, 1997; Nigg, 2001). Additionally, individuals with ADHD and ADHD+CD typically require a higher level of stimulation and engage in more sensation seeking behaviors (Barkley, 1997; Nigg, 2001). They have difficulty controlling prepotent responses and are more persistent in their behaviors (Barkley, 1997; Nigg, 2001). Perhaps because of these core deficits, at least one study has shown adults with ADHD to be more impaired when consuming alcohol than their peers without the disorder (Barkley, Murphy, & O'Connell, 2006). Adolescents and young adults with ADHD and ADHD+CD face additional risk factors for alcohol and substance abuse, including higher rates of parental psychopathology and substance use disorders (SUD; Biederman, et al., 2000; Chronis et al., 2003), social skills deficits (Hinshaw & Nelnick, 1995), and academic impairment (Barkley, 2003). Additionally, there is a striking overlap between executive functioning deficits associated with ADHD and ADHD+CD (Barkley, 1997; Seguin, Nagin, Assaad, & Tremblay, 2004) and those associated with SUD (Giancola & Tarter, 1999; S. Grant, Contoreggi, & London, 2000), including impairment in attention, working memory, and goal persistence. Several studies have found that the risk for SUD increases incrementally with an increasing number of such risk factors (Newcomb, 1995).



Individuals with ADHD are attending college at increasing rates (Wolf, 2001). Advances in the use and effectiveness of psychosocial interventions, psychotropic medications, and legislative support through Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990 have made higher education more accessible to students with ADHD (Gallagher, Sysko, & Zhang, 2001). It is estimated that ADHD symptoms affect 2-4% of college students (DuPaul, et al., 2001; Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999; Weyandt, et al., 2003), and 25% of students registered with the department of student services (DSS) receive services for ADHD (Wolf, 2001). Despite these increases, little is known about how students with ADHD adapt to the developmental challenges that accompany the college years.

For those with ADHD, the transition to college may exacerbate their vulnerability to alcohol- and substance-related problems. Going to college often requires moving away from home, forming a new peer group, meeting new academic standards (Hays & Oxley, 1986), and adapting to an environment where alcohol and heavy drinking are embedded in the culture (Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998). While moving away from home is normative at this stage, those with ADHD may struggle in the absence of the daily structure, organization, and supervision provided by parents (Barkley, 1998). Indeed, all effective psychosocial treatments for ADHD require support and environmental contingencies from parents and teachers, who are no longer closely supervising the individual's behavior (Pelham, et al., 2004). Additionally, the social skills deficits that often accompany ADHD may leave those with the disorder ill-equipped to manage the challenges associated with forming a new peer group. The academic impairments associated with the disorder appear to persist into the college years (Frazier,

Youngstrom, Glutting, & Watkins, 2007), when the decrease structure and support from parents and the school system may exacerbate academic problems. Therefore, while social and academic impairment are risk factors for alcohol and substance abuse problems, they may be particularly potent in the college environment, where alcohol occupies a central place in the social scene (Wechsler, et al., 1998).

A handful of cross-sectional studies have examined correlates of ADHD in college students; however, studies that have been conducted with individuals at this developmental stage have suffered serious methodological limitations. All of these studies, with one exception, have relied solely on self-report rating scales for ADHD assessment and classification (Barkley, 1998; Heiligenstein, et al., 1999; Shaw-Zirt, Popali-Lehane, Chaplin, & Bergman, 2005; Sparks, Javorsky, & Philips, 2004; Weyandt, et al., 2003; Young & Gudjonsson, 2005), which may be particularly problematic in an ADHD population where individuals have been found to underreport the severity of their symptoms (Kooij, et al., 2008). Continuous measures of ADHD symptomatology also do not consider level of impairment or childhood onset; both of which may impact behavior and are required for an ADHD diagnosis (APA, 2000). In addition, when full diagnostic assessments (including structured interviews which consider differential diagnosis) are not utilized, it is unclear whether differences between high and low scorers should be attributed to ADHD or if they are better accounted for by other factors, such as unreported psychopathology. The single study of college students with ADHD that utilized established, psychometrically-sound diagnostic techniques focused exclusively on academic outcomes, and failed to examine social behaviors (Heiligenstein, et al., 1999).

### *Impulsivity and Risky Behaviors Across the Lifespan*

It has been theorized that the symptoms of ADHD arise from a primary deficit in executive functioning. There are a number of different theories that attempt to elucidate the precise nature of this deficit, but it is Barkley's theory of behavioral disinhibition that stands out as being the most highly developed and widely tested. Barkley theorizes that inhibition is primary to other executive functions in that a response must be inhibited long enough to allow other executive functions to occur (Barkley, 1997, 2001).

Inhibition, according to Barkley, encompasses the processes of response inhibition (inhibiting a prepotent response or stopping an ongoing response) and interference control. The inhibitory deficit found in individuals with ADHD causes those with the disorder to behave impulsively and to have difficulty discontinuing actions that others are able to easily stop. Problem solving tasks in which no preconditioned response is immediately available are particularly reliant on the process of response inhibition; as are tasks requiring resistance to temptation or deferred gratification.

Barkley's theory of response disinhibition has been studied extensively in laboratory settings in participants with ADHD and ADHD+CD. A widely used test of behavioral inhibition is the Stop-Signal Task (Logan & Cowan, 1984), which measures participants' reaction time to a visual stimuli and their ability to inhibit a reaction when an auditory signal is presented (Logan, 1994). Individuals with ADHD have consistently been found to perform poorly relative to controls across multiple studies conducted with school-age children, adolescents, young adults, and adults (Barkley, 1997; Fischer, Barkley, Smallish, & Fletcher, 2005; Nigg, 1999; Oosterlaan, Logan, & Sergeant, 2000; Schachar, Mota, Logan, Tannock, & Klim, 2000). Solanto and colleagues (2001)

compared the ecological validity of the Stop Signal Task, described above, and the Choice Delay Task, a measure of delay aversion, with respect to their correlations with classroom observations and with ratings of impulsivity and other core ADHD symptoms. Response patterns on the Stop Signal Task correlated modestly with classroom behavioral observations, and response patterns on the Choice Delay Task were modestly correlated with teacher ratings of impulsivity, hyperactivity, and conduct problems, as well as with observations of gross motor activity, physical aggression, and an overall composite score of ADHD symptoms. These results lend modest support to the validity of these laboratory measures of executive functioning. Although examined less extensively, a handful of studies have found that executive functioning deficits are greatest in children with ADHD+CD (Moffitt, 1990; Moffitt & Henry, 1989; Seguin, et al., 2004). This core deficit in response inhibition characteristic of individuals with ADHD and ADHD+CD is manifested, in part, as a variety of impulsive and often risky behaviors across the lifespan (Barkley, 2001).

#### *Early to Middle Childhood*

In addition to performing poorly on laboratory measures of impulsivity and inattention, there is evidence that individuals with ADHD also engage in more risky behaviors across multiple developmental periods. Preschool and school-age children with the hyperactive or combined subtypes of ADHD, by definition, display developmentally inappropriate levels of impulsivity. According to Barkley (1998), it is often reported clinically that these children react quickly to situations without waiting for complete instructions. These children may also fail to properly assess a situation or consider potentially negative or even dangerous consequences before acting.

Neuropsychological studies using the Stop Signal Task with preschool and school age children have found support for this impulse control deficit (Dimoska, Johnstone, Barry, & Clarke, 2003; Nigg, 1999; Oosterlaan, et al., 2000).

For preschool and school-age children with ADHD, the most dangerous consequence of their engagement in risky behaviors is an increased likelihood of sustaining accidental injuries at higher rates relative to their non-ADHD peers. In a study of preschool children, Lahey and colleagues (1998) found that parents of preschoolers with the hyperactive-impulsive subtype of ADHD were significantly more likely to report a history of at least one unintentional injury than parents of children without ADHD. Two studies examining parental perception of accident proneness in their children found that parents described children with ADHD as “accident prone” four to five times more often than children without ADHD (Mitchell, Aman, Turbott, & Manku, 1987; Stewart, Pitts, Craig, & Dierut, 1966). While at least one study has not found higher rates of accidents among children with ADHD (Barkley, DuPaul, & McMurray, 1990), many have reported that parental reports of injury rates among children participating in studies of ADHD are on average two to four times higher for children with ADHD than for children without the disorder (Barkley, 2002; Jensen, 2002; Taylor, Sandberg, Thorley, & Giles, 1991). One study in particular found that parents of children with ADHD were seven times more likely than parents of children without the disorder to report an injury that they attributed to the child’s carelessness, impulsivity, or poor judgment in the past year (Lahey, et al., 2004).

DiScala and colleagues (1998) examined differences in the nature and severity of injuries and functional outcomes between children with and without ADHD who were

admitted to hospitals participating in the National Pediatric Trauma Registry. They found that injured children with ADHD are more likely to sustain severe injuries than children without the disorder. In a separate study, children with ADHD were admitted to emergency rooms in the United Kingdom at significantly higher rates than children without the disorder (Hoare & Beattie, 2003). Studies examining specific injuries have found bone fractures, dental trauma injuries, and accidental poisoning to be more common in children with ADHD than in those without the disorder (Jensen, Shervette, Xenakis, & Bain, 1988; Sabuncuoglu, Taser, & Berkem, 2005; Stewart, Thatch, & Friedin, 1970; Szatmari, Offord, & Boyle, 1989). Head trauma and burn injuries, however, do not appear to be overrepresented in ADHD samples (Stewart, et al., 1966; Szatmari, et al., 1989). Taken together, these studies suggest that preschool and school-age children with ADHD experience higher rates of accidental injury than their non-disordered peers. Although causation cannot be inferred from these studies, one possible interpretation of the findings is that from a young age individuals with ADHD engage in higher rates of risky behavior than their non-disordered peers.

### *Adolescence*

Fewer studies of adolescents with ADHD have been conducted than with school-age children, but much of what is known about children with ADHD can be extrapolated to adolescence. Barkley (2004a) notes there is no compelling evidence that ADHD symptoms in adolescence are different from those in children with the disorder, although adolescents tend to display fewer symptoms of overt hyperactivity than their school-age counterparts (Biederman, Mick, & Faraone, 2000). The impairments and consequences associated with these symptoms, however, do change and often become more serious

during adolescence. As they mature physically and socially, adolescents with ADHD encounter new risks associated with sexual activity, alcohol and drugs, and operating a motor vehicle.

The risk for substance use and SUD among adolescents with ADHD has become a matter of public and scientific debate in recent years (APA, 2000). Cigarette smoking during adolescence is a major public health concern (Johnson, O'Malley, Bachman, & Schulenberg, 2005), and adolescents with ADHD represent a particularly high risk group. Several studies have found higher rates and earlier initiation of smoking among adolescents with ADHD compared to adolescents without the disorder (Milberger, Biederman, Faraone, Chen, & Jones, 1997a, 1997b; Molina & Pelham, 2003). Researchers have hypothesized that individuals with ADHD may be self-medicating with nicotine, a stimulant known to improve attention and information processing speed (Levin, Conners, Silva, Canu, & March, 2001; Levin, et al., 1998; Levin, et al., 1996; Milberger, Biederman, et al., 1997a, 1997b; Shytle, Silver, Wilkinson, & Sanberg, 2002). This theory has been supported by two studies that found that nicotine improved the clinical severity of ADHD symptoms (Conners, et al., 1996; Poltavski & Petros, 2006).

While nicotine may lessen the severity of ADHD symptoms, cigarette smoking carries direct health risks (e.g., lung cancer, emphysema) and is known to act as a gateway to future alcohol and illicit drug use (Lai, Lai, Page, & McCoy, 2000; Torabi, Bailey, & Majd-Jabbari, 1993). Biederman and colleagues have examined the link between cigarette smoking and ADHD in the context of the gateway hypothesis (Biederman, Faraone, et al., 2006). The investigators found that the correlation between cigarette smoking in early adolescence and alcohol and illicit drug use in mid-to-late

adolescence was significantly stronger in those with ADHD than in those without the disorder. In summary, studies to date show that adolescent smokers with ADHD are more likely than adolescent smokers without ADHD to use illicit drugs during adolescence and are more likely to develop substance-related problems later in life.

Rates of alcohol use in adolescents with ADHD have been examined in the context of several longitudinal studies. There are four major longitudinal studies of children with ADHD, referred to informally as the Montreal, Berkley, New York, and Milwaukee studies, that have examined substance use behaviors in this population (Barkley, Fischer, Edelbrock, & Smallish, 1990; Biederman, et al., 1997; Gittelman, Mannuzza, Shenker, & Bonagura, 1985; Hartsough & Lambert, 1987; Mannuzza, 1999). Overall, the results from these studies do not indicate that adolescents with ADHD are at increased risk for alcohol use or abuse. For example, in the Milwaukee study, those with childhood ADHD had increased rates of alcohol use compared to adolescents without ADHD, but the differences were not statistically significant (Barkley, Fischer, et al., 1990). The Berkley, New York, and Montreal studies, which examined rates of alcohol use disorder (AUD) but did not measure alcohol use continuously, found no significant differences between adolescents with ADHD and those without ADHD (Barkley, Fischer, et al., 1990; Biederman, et al., 1997; Gittelman, et al., 1985; Hartsough & Lambert, 1987; Mannuzza, 1999).

These four longitudinal studies were hampered by a number of methodological limitations that may have contributed to the discordant findings and limited the generalizability of the results. In each, the study of alcohol use was conducted secondary to the initial goal of examining the long-term course of ADHD, and developmentally-



sensitive substance use assessment methods were not employed (Molina & Pelham, 2003). In addition, the age of the adolescents at the time of assessment varied from study to study, and the researchers often attempted to diagnose AUD at ages when rates of this disorder have not yet reached their peak. The researchers also failed to collect data on critical behaviors prognostic of later abuse or dependence, such as age of first substance use (B. F. Grant & Dawson, 1997). Finally, each of these studies enrolled only male participants, and did not exclude participants whose childhood ADHD symptoms remitted by adolescence. Therefore, these results cannot be generalized to females with ADHD, or to all individuals who continue meet criteria for ADHD in adolescence.

Molina and Pelham (2003) aimed to address some of these methodological limitations by using developmentally-sensitive measures of alcohol use, focusing on behaviors that are prognostic of later alcohol abuse and AUD, and examining the role of ADHD in predicting alcohol use and AUD in a sample of adolescents with ADHD. The researchers' use of a predominately male sample, however, prevented them from adequately addressing the gender limitation; therefore, their results cannot be generalized to females with ADHD. Nevertheless, within the confines of this limitation, Molina and Pelham found that adolescents with ADHD were at an increased risk of alcohol use and abuse relative adolescents without ADHD. Surprisingly, childhood inattention predicted later alcohol use to a greater degree than childhood symptoms of hyperactivity-impulsivity or childhood antisocial behaviors, suggesting that specific childhood ADHD symptoms are uniquely related to alcohol use. While the persistence of ADHD into adolescence was found to increase the risk of repetitive drunkenness and alcohol problems, it was the combination of ADHD and conduct disorder during adolescence that

predicted the highest levels of alcohol use and abuse. The findings from Molina and Pelham's study have laid the groundwork for deepening our understanding of the relationship between alcohol use and ADHD; however, the small number of females included in their study limits the generalizability of the results and points to the need for additional research in this area.

Illicit drug use and SUD in adolescents with ADHD has been examined in the four major longitudinal studies described above and in Molina and Pelham's 2003 study. As with the alcohol use findings, results specific to illicit drug use are often contradictory and subject to the same limitations as those related to alcohol use (Barkley, Fischer, et al., 1990; Biederman, et al., 1997; Gittelman, et al., 1985; Hartsough & Lambert, 1987; Mannuzza, 1999). As they did with alcohol use, Molina and Pelham (2003) sought to clarify the discordant illicit substance use findings by employing developmentally-sensitive assessment techniques and by focusing on behaviors that are prognostic of later substance abuse and SUD (i.e., age of first use, lifetime use of any illicit substance). In this study, adolescents with ADHD displayed heavier and earlier use of non-marijuana illicit drugs, and had higher rates of SUD than their peers without ADHD. These results were specific to inhalants, hallucinogens, cocaine, and non-prescribed use of stimulants. The highest rates of SUD were found among adolescents with current ADHD+CD relative to those with ADHD and a non-disordered comparison group. However, when examining substance use independent of SUD, childhood inattentive symptoms again emerged as a key factor, predicting later substance use to a greater degree than childhood hyperactivity-impulsivity or antisocial behaviors.

Substance use during adolescence carries many risks beyond the immediate physical effects of the drug. Adolescent alcohol and drug use has been associated with earlier initiation of sexual intercourse and a higher incidence of risky sexual behavior, defined as engaging in sexual activity with multiple partners and using inconsistent safe-sex practices (Baskin-Sommers & Sommers, 2006; Cooper, Peirce, & Huselid, 1994; Hingson, Strunin, Berlin, & Heeren, 1990; Stanton, et al., 1999). Given that adolescents with ADHD use alcohol and illicit drugs at higher rates than their peers, it is likely that they are also engaging in risky sexual behaviors more frequently. Additionally, the impulsivity often associated with ADHD may increase the likelihood that these adolescents will engage in risky sexual practices without considering the potential health and social consequences (Brown, et al., 1997). To date, no study has examined risky sexual behaviors in a sample of adolescents with ADHD. Participants the Milwaukee longitudinal study, however, were asked about age of first sexual intercourse as part of the young adult follow-up interview. Results indicated that members of the ADHD group typically began having sex at a significantly earlier age than their non-disordered peers (Barkley, 1998).

### *Young Adulthood*

The risky behaviors displayed by adolescents with ADHD often persist into young adulthood (typically defined as 18–25 years). In some instances these behaviors may worsen as individuals achieve greater autonomy and are freed from many of the social control agents, such as their parents and high school teachers and personnel, that were present during adolescence. Studies have shown that substance use during adolescence predicts continued substance use during young adulthood (Bachman,

Wadsworth, O'Malley, Johnston, & Schulenberg, 1997; Johnson, et al., 2005; Kandel, 1975; Kandel, Davies, Karus, & Yamaguchi, 1986; Kandel & Faust, 1975). Given that individuals with ADHD typically begin using alcohol and illicit substances at an earlier age and with greater frequency than their peers, higher rates of substance use and substance use disorder would be expected among this population in young adulthood.

Recent studies have found that ADHD is associated with a greater likelihood of progression from experimental smoking during adolescence to nicotine dependence during young adulthood (Fuemmeler, Kollins, & McClernon, 2007) and that up to more than one-third of young adults with ADHD endorsed using cigarettes for self-medication purposes (Wilens, et al., 2007). In a study of a nationally representative non-clinical young adult sample, each self-reported inattention and hyperactivity/impulsivity symptom significantly increased the likelihood of ever having been a regular smoker when controlling for demographic variables and conduct disorder symptoms (Kollins, McClernon, & Fuemmeler, 2005). In this same study, researchers found that among those reporting lifetime regular smoking, higher numbers of reported ADHD symptoms decreased the estimated age of smoking onset and increased the number of cigarettes smoked.

Longitudinal studies that have compared alcohol use patterns in young adults with ADHD to young adults without the disorder have consistently found no difference in rates of alcohol use between groups (Weiss & Hechtman, 1993; Wilens, Biederman, & Mick, 1998; Wilens, Biederman, & Spencer, 2002). These results are surprising given that ADHD is associated with an early onset of alcohol use (Barkley, Fischer, et al., 1990), which is a known predictor of future alcohol related problems (B. F. Grant &

Dawson, 1997). Smith and colleagues (2002) have suggested that, in contrast to alcohol use during adolescence, alcohol use may be “normative” during young adulthood, and is therefore limited in its predictive power for alcohol-related problems. They propose that rates of alcohol abuse and alcohol use disorder may be the only appropriate predictors of alcohol-related problems at this stage of development. Indeed, in a study of young adults (mean age 25), approximately 44% of those with ADHD met criteria for alcohol abuse or dependence, compared with 27% of those without ADHD (Weiss & Hechtman, 1993). While these findings have been replicated across multiple studies, at least one study has presented contradictory findings (Lambert & Hartsough, 1998), highlighting the need for further research in this area. In addition, these studies did not discriminate between participants attending college in either the ADHD or comparison groups. Given the unique patterns of alcohol use among college students that have been well established in the college student health literature (Johnson, et al., 2005), college student status may be an important variable to consider.

Illicit drug use in young adults with ADHD has been studied less extensively than alcohol use. When illicit drug use has been examined, however, it has primarily been within the context of the four longitudinal studies described previously. These studies found significantly higher levels of illicit drug use among young adults with ADHD compared to those without ADHD (Biederman, Monuteaux, et al., 2006; Hechtman, 1984; Lambert & Hartsough, 1998; Mannuzza & Klein, 2000; Milberger, Biederman, Faraone, Wilens, & Chu, 1997; Weiss, 1979). An important limitation of these studies, however, is the failure of the researchers to consider conduct disorder symptoms when studying levels of substance use. A fifth longitudinal study sought to clarify the results by

examining the use of specific illicit substances in young adulthood and the degree to which childhood conduct problems predicted increased drug use in young adulthood (Barkley, et al., 2004). The researchers found significantly higher rates of drug use in the combined ADHD+CD group compared to the pure ADHD group when measuring use of marijuana, cocaine, LSD/hallucinogens, amphetamines, narcotics, sedatives, and other drugs. In contrast, no differences in illicit drug use were found between the pure ADHD group and the community control group. These results are not surprising when considering Molina and Pelham's (2003) finding that adolescents with ADHD+CD display the most severe substance use behaviors. The relative contribution of childhood conduct disorder to the development of substance abuse or dependence appears to change across the lifespan. In a study adults in their mid-thirties (mean age = 37), ADHD was found to be a risk factor for psychoactive substance use disorder independent of psychiatric comorbidity, including conduct disorder (Biederman, Wilens, Mick, Faraone, & Spencer, 1998; Wilens, et al., 1998). It is not entirely understood why this developmental difference would emerge, although it can be theorized that the normative decline in substance use during adulthood that often accompanies the assumption of adult roles and responsibilities (Johnson, et al., 2005) may differentially affect individuals with and without ADHD. The questions raised by these results and by discordant findings across studies highlight the need for additional developmentally-sensitive research that considers comorbid CD when examining the link between ADHD and illicit substance.

As researchers continue to investigate rates of substance use and substance use disorder among young adults with ADHD, trends in risky sexual activity should be

considered as well. Indeed, studies of young adults have found risky sexual behaviors to be associated with alcohol and drug use (Baskin-Sommers & Sommers, 2006; Schafer, Blanchard, & Fals-Stewart, 1994). To date, only two studies, similar in their sample composition, design and findings, have examined sexual practices in the ADHD population (Barkley, Fischer, Smallish, & Fletcher, 2006; Flory, et al., 2006). In these prospective longitudinal studies of males diagnosed with ADHD during childhood, information about risky sexual behaviors was collected during the studies' young adult follow-up phase. Across studies, participants with ADHD were more likely to engage in risky sexual behavior than participants without the disorder. Specifically, participants with ADHD began having sexual intercourse at an earlier age, had more sexual partners, and were more likely to have intercourse that lead to an unplanned pregnancy. In the study conducted by Barkley and colleagues (2006), individuals with ADHD were more likely to report that they rarely or never used birth control, contracted sexually transmitted diseases at higher rates, and were more likely to have been tested for HIV, although no members from either group reported testing positive. Likewise, Flory and colleagues (2006) reported that young adults with ADHD were more likely to engage in casual sex with infrequent condom use. When examining the impact of comorbid CD on the sexual behavior of young adults with ADHD, the researchers found that ADHD uniquely contributed to the likelihood of a higher-risk sexual lifestyle, but that individuals with ADHD+CD had the highest rates of risky sexual behavior relative to those with pure ADHD and a non-disordered comparison group. Additional research is needed to establish rates of risky sexual behaviors among female young adults with ADHD, to further explore the contribution of conduct disorder to rates of risky sexual

behavior, and to examine differences in risky sexual behavior between young adults with ADHD who are and are not attending college.

Symptoms of impulsivity and inattention and the increased likelihood of substance use place individuals with ADHD at risk for driving-related impairment. The Montreal longitudinal study was the first to examine driving behavior in the ADHD population (Weiss & Hechtman, 1993). This study found that adolescents and young adults with ADHD reported significantly more traffic accidents in which they were a driver and incurred greater damage to their vehicles than those without ADHD. The investigators, however, relied exclusively on self-report data and did not include objective measures of driving performance. Barkley and his colleagues expanded upon this work by conducting a series of studies of adolescents and young adults (ages 17-23) with ADHD that relied on multiple sources of data, including self-reports, parent-reports, official motor vehicle records, and results from a driving simulator task (Barkley, 2004b; Barkley, Fischer, et al., 2006; Barkley, et al., 1993; Barkley & Murphy, 1996; Barkley, Murphy, & DuPaul, 2002). The results from these studies support Weiss and Hechtman's finding that that adolescents and young adults with ADHD are involved in more motor vehicle accidents than their peers without the disorder. The investigators also found that individuals with ADHD had more bodily injuries associated with their accidents and were at fault for more accidents than their non-disordered peers. They were also more likely to receive traffic citations, particularly for speeding, and to have had their license suspended or revoked (Barkley, 2004b; Barkley, et al., 1993; Barkley & Murphy, 1996; Barkley, Murphy, et al., 2002; Barkley, Murphy, et al., 2006). In driving simulator tasks, individuals with ADHD had slower and more variable reaction times and displayed more



erratic control of the vehicle (Barkley, 2004b). Additionally, Barkley and colleagues (2006) found that alcohol consumption lead to greater driving impairment in adults with ADHD than in adults without the disorder. This finding is particularly concerning given the elevated rates of alcohol use in this population.

In summary, these findings highlight multiple domains of risky behavior in which individuals with ADHD are at risk for impairment across the lifespan. The risky behaviors included in these domains, the dangerous consequences associated with these behaviors, and the limitations of studies conducted to date point to the need for additional developmentally-sensitive research in these areas.

#### *College Students with ADHD*

Relative to the information available about children, adolescents, and young adults with ADHD, little information exists about ADHD in the college student population. The college years constitute a formative period during which individuals undergo the transition from adolescence to young adulthood. The emergence of new roles and social environments during college provide increased opportunities for successes and failures, which set the stage for potential discontinuity in functioning and adjustment between adolescence and young adulthood (Aseltine & Gore, 1993; Petersen, 1993). In addition, decisions, experiences, and habits established during the college years can have a significant impact on the future direction of individual's adult life (Clausen, 1991; Schuman & Scott, 1989).

Over thirty years of special education and disability law, including the Individuals with Disabilities Act (IDEA) of 1975, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Act (ADA) enacted by Congress in 1990 (Latham &

Latham, 1996), have allowed many qualified students with disabilities to graduate from high school and enter post-secondary institutions. It is estimated that ADHD symptoms affect 2% to 4% of college students today (DuPaul, et al., 2001; Heiligenstein, et al., 1999; Weyandt, et al., 2003), and that approximately 25% of students registered with university departments of student services (DSS) receive services for ADHD (Wolf, 2001). At the University of Maryland, College Park, the number of students with ADHD who are registered with DSS tripled between the 2002 and 2005 from 126 to 376 (DSS, 2006). However, because college students with ADHD are not required to report to DSS, prevalence estimates based on DSS referrals likely under-represent the actual number of students with ADHD on college campuses. Individuals with ADHD are more likely than ever to attend college (Wolf, 2001), increasing the need for empirically-based information about this population.

Preliminary studies of college students with elevated ADHD symptoms suggest that students with ADHD are at an increased risk for academic problems, are more likely to be on academic probation, and have significantly lower grade point averages than students without the disorder (Heiligenstein, et al., 1999; Weyandt, et al., 2003). Moreover, in a study of young adults with ADHD, Murphy and colleagues found that individuals with ADHD are less likely to graduate from college than their peers without the disorder (K. R. Murphy, Barkley, & Bush, 2002). Existing studies of college students with ADHD are limited by their reliance on continuous self-report measures of ADHD symptoms for group classification and their lack of retrospective and current collateral data (e.g., from parents or school records) regarding the participants' ADHD symptoms. While it appears quite likely that college students with ADHD are at risk for problems in

the academic domain, it is unknown how the disorder may place them at risk in other areas of functioning, including engagement in dangerous patterns of substance use and risky sexual behaviors.

Although, to the best of our knowledge, no studies of risky behavior among college students with ADHD have been published to date, there is ample data available on risky behavior in the general college population. This is particularly true for substance use behaviors, where three large scale projects have been responsible for generating a majority of the data (Meilman, Cashin, McKillip, & Presley, 1998). While the three projects dedicated to this topic overlap in scope, each has a unique focus. The longest running project, the Monitoring the Future Study, is funded by the National Institute on Drug Abuse and has been tracking the substance use habits of high school students, both during high school and after graduation, since 1975 (Johnson, et al., 2005). The study contributes uniquely to the college student literature because it tracks young adults who do not go on to college after high school graduation as well as those who do, allowing for direct comparisons between the two groups (Johnson, et al., 2005). The second project, the Core Alcohol and Drug Survey, was established in 1989 by grantee institutions from the U.S. Department of Education's drug prevention program in higher education (Meilman, et al., 1998). The study's survey instrument is designed to allow universities and colleges to collect their own data regarding alcohol and drug related behaviors on their college campuses. The Core Institute aggregates the findings from all participating institutions and publishes a monograph of the national results every two years (Presley, 1994). The third project, the Harvard School of Public Health College Alcohol Study, funded by the Robert Wood Johnson Foundation, examined college

student drug and alcohol use at four time points: 1993, 1997, 1999, and 2001 (Wechsler, et al., 2002). Heavy episodic drinking and the associated consequences are particular foci of this project, and the lead researcher on the study team, Henry Wechsler, Ph.D., is credited with coining the term “binge drinking” to describe the behavior of consuming 5 or more drinks in a row for men and 4 or more drinks in a row for women (Wechsler, Dowdall, Davenport, & Castillo, 1995). As a result of these large, collaborative projects, a vast amount of data is available on the substance use patterns of college students.

Results from these large scale studies have shown that cigarette smoking occurs less frequently in the college student population than in the general young adult population (5.6% vs. 16%) (Johnson, et al., 2005). The Harvard School of Public Health study has found , however, that college students who smoked cigarettes before the age of 16 are more likely to become regular marijuana users in college and are more likely to have used illicit drugs in the past year (Mohler-Kuo, Lee, & Wechsler, 2003). This finding is not surprising given the gateway hypothesis described above, and it highlights the important role that cigarette smoking may play in future drug use.

Substance use peaks during young adulthood and declines during adulthood in normative samples (Johnson, et al., 2005). This decline has been linked to the assumption of new roles and responsibilities such as marriage, parenthood, and employment, that are incompatible with substance use (Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996). College typically delays the assumption of many adult responsibilities and expands the period during which high levels of substance use can be sustained (Schulenberg, et al., 1996). Alcohol related findings from the Core Alcohol and Drug Survey, the Monitoring the Future Study, and the Harvard School of

Public Health College Alcohol Study consistently show that college students engage in riskier alcohol consumption behaviors than their peers who are not attending college. When reporting on their lifetime use of alcohol, college students tend to be similar to their peers who are not attending college, but were significantly more likely to report having used alcohol when questioned about their use in the past month (68% vs. 59%), a timeframe that may better capture their drinking behavior during the school year specifically (Johnson, et al., 2005). The Monitoring the Future research team has noted that in high school, college-bound students were much less likely to consume alcohol than their peers who did not plan to attend college, which makes their jump in alcohol consumption upon entering college particularly striking (Johnson, et al., 2005). Young adults engage in heavy episodic drinking at rates higher than any other age group, and college students “binge drink” significantly more often than young adults who are not attending college (42% vs. 34%) (Johnson, et al., 2005). Heavy episodic drinking carries serious consequences and places college students at an increased risk for accidental injury, unplanned and unsafe sex, and a host of social and psychological problems (Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994; Wechsler, Lee, Kuo, & Lee, 2000; Wechsler, et al., 2002). In summary, college students engage in higher rates of heavy episodic drinking, a hazardous pattern of alcohol consumption, than their non-college peers despite the fact that during high school rates of alcohol consumption are lowest for college bound students.

Illicit drug use has been increasing on college campuses since the mid-1990s (Mohler-Kuo, et al., 2003), but college students differ only modestly from their non-college peers in their rate of drug use and types of drugs used (Johnson, et al., 2005).

Among college students, the annual prevalence (i.e., use of the drug in the past year) for the use of any illicit drug is 36%, compared to 39% of young adults not attending college (Johnson, et al., 2005). The degree of difference, however, increases significantly when examining any illicit drug other than marijuana, with 19% of college students reporting nonmarijuana illicit drug use in the past year versus 24% of terminal high school graduates. In contrast, annual marijuana use is similar among college students and high school graduates (33% and 34%, respectively). Despite lower rates of non-marijuana illicit drug use among college students than among the general young adult population, illicit drug use, particularly marijuana use, remains a significant problem on college campuses (Johnson, et al., 2005).

Sexual behavior among college students has been assessed in two studies that utilized national samples of college students. The first study, the National College Health Risk Behavior Survey (NCHRBS) was conducted in 1995, and the second study, the National College Health Assessment (NCHA) was conducted in 2003. While both studies surveyed the same population, they asked questions that elicited slightly different types of information. Together they provide a comprehensive picture of risky sexual behavior in the college student population. According to the NCHRBS (Douglas, et al., 1997), 29.6% of college students who engaged in sexual intercourse during the 3 months prior to the survey reported using a condom during their last sexual intercourse, and 79.8% reported using some form of contraception during their last sexual intercourse. Of this group, 27.9% reported using a condom most of the time or always. The NCHA (The American College Health Association, 2005) contained questions specific to negative outcomes associated with risky sex practices. In response to this survey, 26.2% of

college students reported ever being tested for HIV infection, 10.1% of sexually active women reported using emergency contraception within the past academic year, 2.6% of female students who had vaginal intercourse in the past year reported becoming pregnant unintentionally, and 2.0% of male students who had vaginal intercourse in the past year reported impregnating someone unintentionally. The data collected through these national surveys shows that risky sex practices are prevalent on college campus.

In studies of college students, the risky driving behavior typically examined is driving under the influence. Hingson and colleagues (2002) integrated data from the National Highway Traffic Safety Administration, the Centers for Disease Control and Prevention, national coroner studies, census and college enrollment data for 18-24 year olds, the National Household Survey on Drug Abuse, and the College Alcohol Survey to estimate the alcohol-related unintentional injury deaths and accidents among college students. In the year preceding the survey, college students were significantly more likely to drink 5 or more drinks on a single occasion and subsequently drive under the influence of alcohol than their peers who were not attending college. This translates to more than 2 million college students who drive under the influence of alcohol annually, and more than 3 million who ride in a motor vehicle with a driver who has been drinking. While driving behaviors more generally have not typically been studied in college student samples, the large number of college students who drive under the influence of alcohol reflect at least one pattern of risky driving behavior which can have serious, even fatal, consequences.

Taken together, these studies suggest that the college years are a crucial developmental period during which individuals engage in risky behaviors, including high

rates of alcohol use, illicit drug use, inconsistent safe sex practices, and risky driving behavior. The delayed assumption of adulthood roles, the absence of social control agents, relatively easy access to alcohol (Wechsler, Kuo, Lee, & Dowdall, 2000), and immersion in an environment of same-age peers all contribute to the college years being a time of heightened engagement in risky behaviors (Schulenberg, et al., 1996). Although no studies to date have examined risky behavior among college students with ADHD, the unique risk factors posed by the college environment coupled with the tendency for individuals with ADHD to engage in risky behaviors may make college students with this disorder a particularly vulnerable population.

### *Present Study*

Existing literature has established that individuals with ADHD engage in more risky behaviors throughout the lifespan than their non-disordered peers, and that individuals with ADHD+CD tend to engage in the highest rates of risky behavior. It follows that the impulsive and inattentive symptoms characteristic of individuals with ADHD may impair their ability to make safe choices within the context of the college environment when social control agents that had previously provided supervision and support are no longer present.

*Primary Aim:* To examine whether the presence of ADHD contributes unique variance to the prediction of risky behavior among college students, while considering the role of comorbid CD. Risky behaviors under examination include: tobacco use, alcohol use, illicit drug use, unsafe sex practices, and engaging in risky driving behaviors.

It is hypothesized that ADHD will be significantly associated each of the outcome variables when controlling for comorbid CD and associated demographic variables.



Specifically, ADHD and ADHD+CD will predict higher rates of cigarette smoking, alcohol consumption, illicit drug use, unsafe sexual practices, and risky driving habits in college students. While no empirical evidence exists for rates of these behaviors among college students with ADHD, research on adolescents and young adults with ADHD support these expectations.

*Secondary Aims:*

1. To examine whether the comorbidity of ADHD and CD is associated with the highest rates of risky behavior among college students.

It is hypothesized that that ADHD+CD will be significantly associated with each of the risky behaviors evaluated herein after considering the variance accounted for by ADHD and CD independently.

2. To examine whether significant associations between ADHD and ADHD+CD and the outcome variables are maintained when depression is considered in the models.

Despite the fact that links between depression and substance use have been established in the literature (Pardini, White, & Stouthamer-Loeber, 2007; Patock-Peckham & Morgan-Lopez, 2007), it is hypothesized that significant associations between ADHD and ADHD+CD and the outcome variables will be maintained even when elevated levels of depression are considered in the model.

*Method*

*Participants:* Participants included 39 University of Maryland college students with ADHD and 60 University of Maryland college students without ADHD.

Participants included in the ADHD group met the following criteria: (1) met full diagnostic criteria as specified in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; APA, 1994), according to self and parent reports, with one exception; the threshold for diagnosis was set at five current symptoms in either the inattentive or hyperactive-impulsive category rather than the six symptoms specified in the DSM (McGough & Barkley, 2004); (2) were enrolled as a full-time undergraduate student at the University of Maryland for at least the past six months; (3) and lived independently away from their parents for the past six months. Students who were taking medication to treat ADHD, as well as students who are not taking medication, were included in this study. Students in the comparison group: (1) had fewer than three current DSM-IV symptoms of ADHD and no history of the disorder according to self and parent reports; (2) had never been prescribed medication to treat ADHD; (3) were enrolled as a full-time undergraduate student at the University of Maryland for a minimum of six months; (4) lived independently away from their parents for the past six months. Students with one or more Axis I disorder other than ADHD, including a learning disability, were eligible to participate in either group.

### *Materials*

*ADHD Diagnostic Measures:* The Conners Adult ADHD Rating Scale – Long Version (CAARS – LV; Conners et al, 1999; Erhardt, Epstein, Conners, Parker & Sitarenios, 1999a, 1999b) was administered for screening purposes to a large pool of potential subjects. This measure has excellent psychometric properties and allows for the generation of an ADHD symptom profile that can be compared against established age and gender norms. The CAARS – LV is a 93-item, reliable and valid measure of current

ADHD symptoms in a form suitable for adults (Conners, et al., 1999; Erhardt, et al., 1999a). Students with scores at or above 60 on the ADHD Index, a score that is one standard deviation above the mean, at the time of the telephone or mass screening were invited to attend a laboratory session during which structured diagnostic interviews were conducted to establish ADHD and CD diagnoses and to determine eligibility for inclusion in the ADHD group.

Final group classification was determined through the administration of the Schedule for Affective Disorders for School-Aged Children ADHD module (K-SADS; Orvaschel & Puig-Antich, 1995) modified for current and lifetime self-report by adults (Faraone, Biederman, Feighner, & Monuteaux, 2000), and through rating forms completed by parents about participants' past and current ADHD symptoms.

Establishing a childhood history of ADHD is essential to the diagnosis of the disorder during adolescence or adulthood (McGough & Barkley, 2004). However, studies of the accuracy of retrospective recall of childhood ADHD symptoms and reports of current symptoms by adults with the disorder have produced mixed results (Mannuzza, Klein, Klein, Bessler, & ShROUT, 2002; P. Murphy & Schachar, 2000). Given that research suggests adults with ADHD have limited awareness of their problems (P. Murphy & Schachar, 2000), and that collateral reports of past ADHD symptoms add unique variance to the diagnosis of ADHD in adults (P. Murphy & Schachar, 2000; Zucker, Morris, Ingram, Morris, & Bakeman, 2002), the current diagnostic practices recommend obtaining symptom reports from an individual who had frequent contact with the participant when he was a child and one who has frequent contact with the participant currently (McGough & Barkley, 2004). In the current study, past and current collateral

reports of ADHD symptoms were obtained from parents of participants. Specifically, parents completed the Current ADHD Symptom Scale – Other Reporter (Barkley & Murphy, 2006a) and the Childhood ADHD Symptom Scale – Other Reporter (Barkley & Murphy, 2006a) via mail. Only parents of participants who signed the appropriate release form were contacted for participation. A participant’s refusal to grant permission to contact his or her parents, or a parents’ refusal to complete forms did not preclude the participants’ inclusion in the study. Parents did not receive compensation for their participation. Symptoms endorsed by the participant during the K-SADS interview or by the participant’s parent on the self-report forms will be counted toward the ADHD diagnosis. In the event that parent ratings were not available, ADHD group classification was based solely on participant responses. A majority of participants in the ADHD group provided authorization for parent contact ( $n=34$ ), whereas very few in the non-ADHD group authorized contact ( $n=10$ ).

*Measures of other Psychopathology:* Depression has been identified as a risk factor for substance use (Pardini, et al., 2007; Patock-Peckham & Morgan-Lopez, 2007) and conversely, it has been found that substance use can predict the development of depressive symptoms (Goldstein, Asarnow, Jaycox, Shoptaw, & Murray, 2007). Therefore, participants completed the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977) as a measure of current depression symptoms. The CES-D is a 20 item self-report scale designed to measure depressive symptomology in a general population. Items are scored on a scale of 0 (“rarely or none of the time”) to 3 (“most or all of the time”). Possible scores range from 0 to 60 with cut-off score of 16 used to indicate clinical levels of depressive symptomology. The CES-D has been shown to have

high internal, cocurrent, and predictive validity (Husaini, Neff, Harrington, Hughes, & Segal, 1980; Radloff, 1977). Clinical levels of depressive symptomology were considered in statistical analyses to examine the extent to which our findings related to ADHD and ADHD+CD remained when clinical depression was controlled.

Symptoms associated with Learning Disabilities (LD) may also be associated with many of the behaviors being studied (Maag, Irvin, Reid, & Vasa, 1994). The comprehensive neuropsychological assessment required to adequately test for learning disabilities was beyond the scope of this project, however, participant responses to an open ended question about previous LD diagnoses were captured. High rates of LD comorbidity among individuals with ADHD, ranging from 8% to 39% depending on the type of LD and the diagnostic criteria employed (Barkley, 1998), make excluding students with dual diagnoses prohibitive; however, effects of learning disabilities were considered in statistical analysis.

Individuals with ADHD will be included in the study regardless of ADHD medication status. Considering medication is important, however, because recent studies have shown that stimulant medication decreases the likelihood that adolescents with ADHD will smoke cigarettes or use illicit drugs when compared to their peers with ADHD who are not taking stimulant medication (Biederman, 2003; Biederman, et al., 2005). Medication type, dosage, and compliance ratings were obtained from all subjects currently taking ADHD medications, and medication status was considered in statistical analyses.

*Measure of Substance Use:* Many widely used surveys are available for collecting information on college student alcohol and psychoactive substance use. The

Core Alcohol and Drug Survey (Core Institute, 1994) was selected because it is particularly relevant to this developmental stage and the college context and has strong psychometric properties (Core Institute, 2005). The Core Survey is a 39-item, forced-choice response survey that has been used extensively at 157 post-secondary institutions (Core Institute, 2005). Test-retest reliability for most items is between .61 and 1.00 (Core Institute, 2005). In addition, test-retest correlations for certain alcohol and drug use items such as frequency of alcohol, tobacco, cocaine, and amphetamine use over the past 30 days and age of first use ranged between .97 and 1.00 (Core Institute, 2005). According to content-related validity, interrater agreement for item inclusion was .90, signifying a high level of agreement on the inclusion of survey items by experts (Core Institute, 2005). The survey also demonstrates strong intercorrelations for alcohol and drug use and consequences.

The CORE alcohol and drug survey items targeting alcohol and drug use over the past 30 days are presented in a forced-choice format where respondents are asked to select how many times in the past 30 days they have used alcohol or a specific drug (e.g., “During the past 30 days on how many days did you have tobacco: 0 days, 1-2 days, 3-5 days, 6-9 days, 10-19 days, 20-29 days, All 30 days.”). Although the CORE alcohol and drug survey contains items about substance use during the past 30 days as well as the past year, our study will only focus on responses to the past 30 days question because we were interested specifically in the time period during which students were living on campus and away from home.

The Alcohol Use Disorders Identification Test (AUDIT) was administered to participants with the goal of obtaining continuous scores reflective of the participant’s

level of alcohol-related risk (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). The AUDIT self-report questionnaire consists of 10 items comprised of three subscales, including: a quantity and frequency subscale (i.e., “How often do you have a drink containing alcohol?” “How many units of alcohol do you drink on a typical day when you are drinking?” “How often do you have 6 or more units of alcohol on one occasion?”); a dependence or emerging dependence subscale (i.e., “How often during the last year have you found that you were not able to stop drinking once you started?” “How often during the last year have you found that you failed to do what was normally expected of you because of drinking?” “How often during the last year have you needed a first drink in the morning to get you going after a heavy drinking session?”); and a current harm subscale (i.e., “How often during the last year have you had a feeling of guilt or remorse after drinking?” “How often during the last year have you been unable to remember what happened the night before because you had been drinking?” “Have you or someone else been injured as a result of your drinking?” “Has a relative or friend or doctor or another health worker been concerned about your drinking or suggested that you cut down?”).

The Drug Use Disorders Identification Test (DUDIT), like the AUDIT provides a continuous score that takes into account the quantity and frequency of drug use and related impairment (Berman, Bergman, Palmstierna, & Schlyter, 2005). The DUDIT is an 11-item self-report instrument intended for use with the AUDIT. The DUDIT was modified for this study to obtain separate scores for marijuana and nonmarijuana illicit drug use. This modification was based on studies of illicit drug use in college students

and young adults which found significant differences in level of use when marijuana use was considered independent of other illicit drug use (Johnson, et al., 2005).

*Measure of Sexual Behavior:* Sexual behavior was evaluated using the five questions related to sexual behavior from the HIV Risk Behavior Scale (HRBS; Darke, Hall, Heather, Ward, & Wodak, 1991). Participant responses were based on their behavior during the past six months. The HRBS was selected because a composite score is easily created when items are tallied, and because it has strong psychometric properties (Petry, 2001). The psychometric properties of this measure, however, have not been validated in the college student or young adult population to the best of our knowledge. The HRBS was supplemented with items used by Flory and colleagues (2006) and Barkley and colleagues (2006) in their studies of young adults with ADHD. These questions included: (1) At what age did you first have penetrative sex?; (2) How many sexual partners have you had in your lifetime?; (3) Have you or your partner(s) ever used emergency contraception (“morning after pill”)?; (4) Have you ever unintentionally become pregnant or gotten someone else pregnant; (5) Have you ever been tested for HIV; (6) Have you ever been diagnosed with a sexually transmitted disease.

*Measure of Driving Habits:* Driving habits were measured using the Driving History Survey (Barkley & Murphy, 2006b). The survey asked participants to report on the frequency with which 12 negative driving outcomes have ever occurred. Data from a study conducted by Barkley, Murphy and colleagues (2002), which used this measure suggest that it is a valid index of driving history when compared to objective indices. Correlations between official Department of Motor Vehicles (DMV) records and self-reported incidents on the Driving History Survey were positive and significant (for



collisions,  $r = .41, p < .001$ ; for speeding citations,  $r = .60, p < .001$ ; for total driving citations,  $r = .39, p < .001$ ).

*Procedures:* Participants in the ADHD group were recruited through flyers posted in buildings on campus and the PSYC100 subject pool. Participants in the non-ADHD group were recruited through the PSYC100 pool of students. Students responding to flyers called the University of Maryland ADHD Laboratory, and were administered a brief telephone screen by a graduate student or a trained undergraduate research assistant to determine eligibility based on the inclusion/exclusion criteria described above. At this stage, the short version of the CAARS, the CAARS-SV, was substituted for the CAARS-LV. Eligible participants (i.e., those with CAARS T-scores at or above 60 for the ADHD group and below 60 for the non-ADHD group) were scheduled for a full assessment, and completed the full CAARS-LV in person at the time of assessment. Students who participated through the PSYC100 pool completed the CAARS-LV as part of the PSYC100 initial screening packet administered to all subject pool participants. Participants elected to sign-up for study participation through the on-line subject pool system. Two separate study listings were posted on the sign-up system, one targeting all college students who met the minimum criteria specified in the participants section and one targeting all college students with ADHD who met the minimum criteria specified in the participants section. As subjects signed-up for participation their CAARS T-scores were checked to ensure that only those with T-scores above 60 were included in the ADHD group and only those with T-scores at or below 60 were included in the non-ADHD group. It was expected that obtaining an equal number of males and females in the ADHD group would be challenging given that in epidemiological samples of children

with ADHD males outnumber females by ratios that range from 2:1 to 9:1 (Biederman, Faraone, Keenan, Knee, & Tsuang, 1990; Gittelman, et al., 1985; Weiss, 1985).

Students meeting the basic inclusion/exclusion criteria were scheduled for an assessment at the University of Maryland Psychology Clinic. Assessments were conducted by a graduate student under the supervision of Andrea Chronis-Tuscano, Ph.D., a licensed clinical psychologist, and an undergraduate research assistant. Participants responded to interviewer questions from the ADHD and CD modules from the modified K-SADS and completed six self-report measures including the CORE Alcohol and Drug Survey, the Driving History Survey, the HIV Risk Behavior Survey, the Center for Epidemiological Studies – Depression Survey, and a demographics form. Additionally, copies of the Childhood Symptoms Scale – Other Report Form (Barkley & Murphy, 2006a) and the Current Symptoms Scale – Other Report Form (Barkley & Murphy, 2006a) were mailed to parents for completion. These forms were only mailed to parents after a release form was signed by students. Every effort was made to contact parents to elicit their participation, but subjects were not excluded if their parents decline to participate or the participant did not wish for their parents to be contacted.

Students who received elevated scores on the CES-D or who requested referrals for psychological treatment were referred to the University Health Center. Participants recruited through flyer postings were paid \$12.00 for their participation, and those recruited through the PSYC100 subject pool received course credit.

### *Design Considerations*

Comorbid diagnoses are present with ADHD in approximately 70% of adult cases (Biederman, 2004). Therefore, a sample of subjects with pure ADHD would not be

representative of the ADHD population and therefore not generalizable. As such, participants with comorbid Axis I disorders were included.

We chose to include students who are taking medication to treat ADHD symptoms. To the best of our knowledge, there is currently no published data available on the proportion of college students with ADHD who are receiving medication treatment; however based on information provided by the Centers for Disease Control, 56% of children aged 4-17 years are taking medication for ADHD (Bloom, Dey, & Freeman, 2005). Indeed, 64% of our ADHD sample was taking ADHD medication at the time of assessment (see Table 1).

The decision to use a lower symptom count for inclusion in the ADHD group than is currently specified in the DSM was based on previous work by Biederman and colleagues and on results from a study of ADHD symptoms in college students (Heiligenstein, et al., 1998). Researchers have often noted that the ADHD diagnostic criteria included in the DSM are specific to children and fail to consider developmental differences in the manifestation of the disorder in adolescents and adults (Barkley, Fischer, et al., 2002; Biederman, Mick, et al., 2000; Lahey, et al., 1994). Indeed, the DSM-IV ADHD diagnosis is based on field trials that examined symptoms in male youth aged 4 through 17, and are therefore not entirely applicable to females or adults (Barkley, Fischer, et al., 2002; Biederman, Mick, et al., 2000; Lahey, et al., 1994). A number of longitudinal studies have found that ADHD symptoms typically decline with age, however, corresponding changes in level of impairment have typically not been examined (Hechtman, 1983; Mannuzza & Klein, 2000; Weiss & Hechtman, 1993). When impairment was considered in a longitudinal study investigating the young adult outcome

of males diagnosed with ADHD during childhood, the investigators found that a majority of the participants continued to struggle with a substantial number of symptoms and high levels of impairment despite no longer meeting full DSM-IV diagnostic criteria for the disorder (2000). In a study of college students, Heiligenstein and colleagues (Heiligenstein, et al., 1998) used self-report ADHD rating scales to identify cutoff scores, based on a difference of 1.5 SD from the mean, that would sufficiently identify college students with significantly high levels of ADHD symptoms. The investigators found that cutoff scores of 4 current symptoms of inattention and hyperactivity-impulsivity were sufficient to identify a college student as distinct from the norm. These findings provide preliminary evidence that the current DSM-IV thresholds for ADHD diagnosis are too high when applied to college students. Murphy and Barkley (1996) studied the prevalence of DSM-IV symptoms in a group of adults and found that DSM criteria for diagnosis of ADHD in children, which typically captures children who are 1.5 standard deviation above the mean, identified adults who were a full 2 to 4 standard deviations above mean for their age group (K. R. Murphy & Barkley, 1996).

Collectively, available evidence suggests that a threshold of six symptoms from either the hyperactivity-impulsivity category or the inattentive category may be too stringent for adults with the disorder. The literature on this topic, however, is still in its infancy and clear guidelines for the diagnosis of adult ADHD have not yet been established. Considering the current findings and practices, we have set the threshold for inclusion in the ADHD group at four symptoms from either the hyperactivity-impulsivity category or the inattentive category. With this threshold we aim to identify a sample that is sufficiently impaired without being overly restrictive. The threshold for inclusion in

the comparison group has been set at fewer than 4 symptoms in either category. This threshold represents an effort to exclude students who may have levels of impairment consistent with an ADHD diagnosis without being overly exclusive in a manner that would result in a comparison group that is not representative of the general college student population.

## Results

### *Analytic Strategy*

The extent to which ADHD diagnosis, CD diagnosis, and the interaction/comorbidity of ADHD and CD were associated with the outcome was examined through regression analyses. Outcome variables were, by and large, selected based on their similarity to outcome variables examined in studies, cited above, of risky behavior in ADHD or college student samples. A majority of the studies that have examined risky behavior in these populations have relied on individual items as outcome variables (e.g., “How many times have you used marijuana in the past 30 days?”) rather than on composite scores. In the present study, we utilized composite scores as outcome variables whenever possible, but also ran analyses on single items for the purposes of comparing the results of the current study with existing findings.

Prior to running regression analyses for each outcome variable, preliminary analyses were conducted to examine the extent to which the demographic variables of age, race/ethnicity, gender, fraternity or sorority membership, and current ADHD medication status, as well as LD diagnosis, and elevated levels of depressive symptomatology (i.e. a total score of 16 or higher on the CESD) were associated with the outcome variables. Demographic variables associated with the outcome variable at a

significance level of  $p < .05$  were included in the first step of the regression equation for each outcome variable. ADHD and CD diagnosis were entered on the second step when significant demographic variables were included, or on the first step in cases where no significant demographic variables were found. The interaction between ADHD and CD was always entered on the last step of the regression equation. Descriptive statistics for demographic predictor variables are presented in Table 1.

All dependent variables were examined for frequency, variability, and the identification of outliers prior to conducting analyses. Frequency and variability were sufficient for most dependent variables but were limited on others. Specifically, two classifications of illicit drug use were not endorsed by any participants (i.e. steroids and “other illicit drugs”) and were therefore not included in the analysis. Other illicit drugs were endorsed with limited frequency, and therefore the decision was made to create composite scores of non-marijuana illicit drugs when examining having rates of having ever used illicit drugs and frequency of drug use over the past 30 days. This decision is consistent with previous research in both the ADHD (Flory, Milich, Lynam, Leukefeld, & Clayton, 2003; Molina & Pelham, 2003) and college student health literatures (Johnson et al., 2005). Regarding risky sexual behaviors, anal sex was endorsed by only one participant and having ever paid for sex was not endorsed by any participants. These items were therefore dropped from the analyses. Among variables related to driving history, only one participant endorsed having ever struck a pedestrian or cyclist while driving, and this item was also dropped from the analyses. Across all dependent variables, no outliers were identified and as a result, all participant responses were included in the analyses.

All hypothesized relationships were tested using regression analyses. Linear regression was employed in a majority of the analyses. Logistic regression techniques were utilized in instances where the dependent variable was dichotomized (e.g., ever used tobacco, ever used emergency contraception).

### *Substance Use*

#### *Tobacco*

Logistic regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and ADHD+CD were associated with having ever used tobacco. Preliminary analyses suggested that age was the only demographic variable significantly associated with ever using tobacco. Specifically, older age was associated with a greater likelihood have having ever used tobacco. In the model that included age, ADHD diagnosis, and CD diagnosis, the association between ADHD diagnosis and having ever used tobacco was marginally significant ( $p=.05$ ) ( $OR = 2.46$ ;  $CI = .977-6.295$ ) when controlling for age and CD. When the interaction term (ADHD x CD) was added to the model, it was not associated with a greater likelihood of having ever used tobacco (see Table 2a).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with level of tobacco use in the past thirty days. Preliminary analyses again suggested that older age was associated with greater frequency of tobacco use over the past thirty days. In the model that included age, ADHD diagnosis, and CD diagnosis, the presence of an ADHD diagnosis was significantly associated with higher levels of tobacco use over the past 30 days ( $\beta = .217$ ,  $p = .03$ ), when controlling for age and CD status. This model explained

9.9% of the variance in level of tobacco use in the past 30 days. When the interaction term was added to the model, it did not contribute added variance to the level of tobacco use over the past 30 days (see Table 2b).

In summary, the association between ADHD and tobacco use was associated with higher levels of tobacco use was supported in that individuals with ADHD reported using tobacco with greater frequency over the past thirty days than their non-disordered peers. A trend emerged for an association between an ADHD and an increased likelihood of having ever used tobacco. Both of these findings were present when controlling for significant demographic variables and for CD diagnosis. The hypothesis that the interaction of ADHD and CD would confer the highest levels of use was not supported.

#### *Alcohol*

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and ADHD+CD were associated with the total score on the AUDIT and with three subscores on the AUDIT: a quantity-frequency subscore, a dependence or emerging dependence subscore, and a harmful or hazardous use subscore. Preliminary analyses suggested that membership in a fraternity or sorority was significantly associated with each of the AUDIT scores (i.e. total score and each of the three subscores). This was the only demographic variable associated with any of the AUDIT scores, and therefore it was the only demographic variable included in these models.

In the model that included fraternity-sorority membership, ADHD diagnosis and CD diagnosis, the presence of an ADHD diagnosis was significantly associated with the AUDIT total score ( $\beta = .221, p = .03$ ) when controlling for the other variables in the



model. When the interaction term was added to the model, it was not found to be associated with the outcome variable (see Table 2c).

Linear regression analyses were also conducted to determine the extent to which ADHD diagnosis, CD diagnosis, and ADHD+CD were associated an AUDIT subscore indicating the quantity and frequency of alcohol consumption. In the model that included fraternity-sorority membership, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD diagnosis was found to be associated with the quantity-frequency subscore. When the interaction term was added to the model, it was also not found to be associated with the quantity-frequency subscore (see Table 2c).

Next, linear regression analyses were conducted to determine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with an AUDIT subscore indicating alcohol dependence or emerging dependence. In the model that included fraternity-sorority membership, ADHD diagnosis, and CD diagnosis, the presence of an ADHD diagnosis was associated with the AUDIT dependence subscore ( $\beta = .227, p = .02$ ), when controlling for CD and fraternity-sorority membership. When the interaction term was added to the model, it was not found to be associated with the outcome variable (see Table 2c).

Finally, linear regression analyses were conducted to determine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated an AUDIT subscore indicating current harmful or hazardous patterns of alcohol use (e.g. How often have you been able to remember what happened while you were drinking?, Have you or someone else ever been injured as a result of your drinking?). In the model that included fraternity-sorority membership, ADHD diagnosis,

and CD diagnosis, neither ADHD nor CD diagnosis was found to be associated with the harm subscore. When ADHD+CD was added to the model, it was also nonsignificant (see Table 2c).

In summary, ADHD was significantly associated with alcohol dependence or emerging dependence when controlling for fraternity-sorority membership and CD diagnosis. ADHD was not found to be associated with quantity and frequency of alcohol use or with hazardous patterns of use. The interaction of ADHD and CD was not associated with any of the alcohol-related outcome measures.

### *Marijuana*

Logistic regression analyses were conducted to examine the extent to which ADHD diagnoses, CD diagnoses, and the interaction of ADHD and CD were associated with having ever used marijuana. Preliminary analyses suggested that age was the only demographic variable associated with the outcome variable. Specifically, older age was associated with a greater likelihood have having ever used marijuana. In the model that included age, ADHD diagnosis, and CD diagnosis, ADHD was significantly associated with a greater likelihood of having ever used marijuana ( $p=.02$ ;  $CI=1.139-10.261$ ) when controlling for age and CD. Specifically, individuals with ADHD are 3.42 times more likely to have ever used marijuana than their peers without the disorder. When the interaction term was added to the model, it was not found to be associated with a greater likelihood of having ever used marijuana (see Table 2a).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the DUDIT-M total score. Preliminary analyses suggested that gender was the only

demographic variable associated with the total score on the DUDIT-M. Specifically, being female was associated with lower total scores on this measure. In the model that included gender, ADHD diagnosis, and CD diagnosis, the presence of a CD diagnosis was significantly associated with the DUDIT-M total score ( $\beta = .215$ ,  $p = .03$ ). That is, those with CD had significantly higher scores on the DUDIT-M than individuals without CD when ADHD diagnosis and gender were considered in the model. This model explained 12.8% of the variance in DUDIT-M total scores. When the interaction term was added to the model, it was not found to be associated with the outcome variable (see Table 2d).

Next, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with frequency of marijuana use in the past 30 days. Results of preliminary analyses suggested that none of the demographic variables were associated with this outcome variable. In the model that included ADHD diagnosis and CD diagnosis, neither predictor variable was found to be associated level of marijuana use over the past 30 days. When the interaction term was added to the model, it was also not found to be associated with level of marijuana use over the past 30 days (see Table 2b).

In summary, ADHD was significantly associated with a greater likelihood of ever having used marijuana in comparison to non-disordered peers, but was not associated with frequency or marijuana-related impairment. The interaction of ADHD and CD was not associated with any of the marijuana outcome variables. CD was, however, independently associated with higher total scores on a measure of drug-related impairment (DUDIT-M) when controlling for ADHD.

### *Non-Marijuana Illicit Drugs*

Logistic regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with having ever used non-marijuana illicit drugs. Preliminary analyses suggested that age was associated with a greater likelihood of having ever used non-marijuana illicit drugs. In the model that included age, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD diagnosis was significantly associated with the outcome variable. The interaction of ADHD and CD was also nonsignificant (see Table 2a).

Linear regression analyses were then conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and ADHD+CD were associated with the DUDIT-N total score. Results of preliminary analyses suggested that none of the demographic variables were associated with the DUDIT-N total score. In the model that included ADHD diagnosis and CD diagnosis, neither predictor variable was found to be associated with the DUDIT-N total score. When the interaction term was added to the model, it was also not associated with the total score (see Table 2e).

Finally, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of times participants used non-marijuana illicit drugs during the past 30 days. None of the demographic variables were associated with level of non-marijuana illicit drug use over the past 30 days. In the model that included ADHD diagnosis and CD diagnosis, CD diagnosis was associated with the level of non-marijuana illicit drug use in the past 30 days ( $\beta = .231, p = .02$ ), however, ADHD diagnosis was not. When the interaction term was added to the model, the interaction between ADHD and CD

diagnosis was significantly related to level of non-marijuana illicit drug use during the past 30 days ( $\beta = .392$ ,  $p = .04$ ) and adding the interaction term to the model accounted for an additional 4.1% of the variance (see Table 2c).

In summary, the interaction of ADHD and CD was significantly associated with a higher frequency of non-marijuana illicit drug use. CD was also significantly associated with a higher frequency of non-marijuana illicit drug use. ADHD alone, however, was not associated with any of the non-marijuana illicit drug outcome variables.

#### *Risky Sex*

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the HRBS composite score. Preliminary analyses suggested that age was the only demographic variable associated with this outcome variable. In the model that included age, ADHD, and CD, ADHD diagnosis was marginally associated with the HRBS composite score ( $\beta = .175$ ,  $p = .09$ ), when considering age and CD. This model accounted for 9.5% of the variance. When the interaction term was added to the model, it was not associated with the HRBS composite score (see Table 3g).

Regression analyses were then conducted to examine specific items from the HRBS and specific items added to the measure. First, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with age at first sexual intercourse. Preliminary analyses suggested that age was the only demographic variable that was significantly associated with the outcome variable; older participants had their first sexual intercourse experience at a later age than younger participants. In the model that included

age, ADHD diagnosis, and CD diagnosis, the association between ADHD diagnosis age at first intercourse was marginally significant ( $\beta = .531, p = .08$ ), when controlling for age and CD status. This model explained 8.9% of the variance. When the interaction term was added to the model, it was not significantly associated with the outcome variable (see Table 3a).

Linear regression analyses were then conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of penetrative sex partners. Results of these preliminary analyses suggested that age was significantly associated with the outcome variable such that older age was associated with a higher number of penetrative sex partners. In the model that included age, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD diagnosis was associated with number of penetrative sex partners. When the interaction term was added to the model, it was also not associated with number of penetrative sex partners (see Table 3b).

Next, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with lifetime number of sex partners, including both penetrative and non-penetrative sex partners. No demographic variables were found to be associated with this outcome variable. In the model that included ADHD diagnosis and CD diagnosis, the presence of a CD diagnosis was found to be significantly associated with a greater number of sex partners ( $\beta = .221, p = .03$ ) when controlling for ADHD diagnosis. This model accounted for 6.3% of the variance. When the interaction term was added to the model it was not associated with the outcome variable (see Table 3c).

In exploratory analyses, the total number of sex partners variable was dichotomized into high risk and low risk categories to be consistent with previous studies conducted by Grunbaum et al. (2004) and Flory et al. (2006). In this case, as in previous studies, having had four or more sex partners, penetrative or non-penetrative, constitutes high risk behavior. Logistic regression analyses were conducted to examine the association between ADHD diagnosis, CD diagnosis, and the interaction between ADHD and CD and having four or more sex partners. Preliminary analyses indicated that medication status was the only demographic variable associated with the outcome variable. Specifically, current ADHD medication use was significantly associated with a greater likelihood of having four or more sex partners. In the model that included medication status, ADHD diagnosis, and CD diagnosis neither ADHD nor CD diagnosis were associated with having four or more sex partners. When the interaction term was added to the model, it was also nonsignificant (see Table 3f).

Given that medication status was significantly associated with the likelihood of having four or more sex partners, and that only those with ADHD were currently taking ADHD medication, exploratory analyses were conducted to examine group differences between those with ADHD who were taking medication and those with ADHD who were not taking medication. Among those with ADHD, group differences based on medication status in having four or more sex partners were nonsignificant.

Next, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the frequency of condom use with a regular sex partner. Preliminary analyses suggested that gender was the only demographic variable associated with frequency of

condom use with a regular sex partner. Specifically, females were more likely to use a condom with a regular sex partner than males. In the model that included gender, ADHD diagnosis, and CD diagnosis, the presence of ADHD was found to be marginally associated with less frequent condom use with a regular sex partner ( $\beta = .203, p = .05$ ), when controlling for CD and gender. This model accounted for 9.9% of the variance. When the interaction between ADHD and CD was added to the model, the interaction term was also marginally associated with less frequent condom use with a regular sex partner ( $\beta = .203, p = .07$ ). Adding the interaction term to the model accounted for an additional 3.1%, a change that was marginally significant ( $p = .07$ ) (see Table 3c).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with frequency of condom use with casual sex partners. None of the demographic variables were associated with this outcome variable. In the model that included ADHD diagnosis and CD diagnosis neither predictor variable was associated with frequency of condom use with casual sex partners. When the interaction term was added to the model, it was also nonsignificant (see Table 3c).

Linear regression analyses were then conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with number of sexually transmitted disease (STD) diagnoses. Preliminary analyses indicated that age and medication status were associated with number of STD diagnoses. Specifically, older age and currently taking ADHD medication were associated with having had a greater number of STD diagnoses. In the model that included age, medication status, ADHD diagnosis, and CD diagnosis, neither ADHD diagnosis nor CD



diagnosis was associated with number of STD diagnoses. When the interaction term was added to the model it was also nonsignificant (see Table 3d).

Given that medication status was significantly associated with the number of times participants had been diagnosed with an STD, and that only those with ADHD were currently taking ADHD medication, exploratory analyses were conducted to examine group differences between those with ADHD who were taking medication and those with ADHD who were not taking medication. Among those with ADHD, group differences, based on medication status, in the number of times participants had been diagnosed with an STD were nonsignificant.

Linear regression analyses were also conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with frequency of Human Immunodeficiency Virus (HIV) testing. Preliminary analyses indicated that age was the only demographic variable associated with this outcome variable. Specifically, older age was associated with having been tested for HIV more often. In the model that included age, ADHD, and CD, neither ADHD nor CD was associated with more frequent HIV testing. When ADHD+CD was added to the model it was also nonsignificant (see Table 3e).

Logistic regression analyses were conducted to examine the association between ADHD diagnosis, CD diagnosis, and the interaction between ADHD and CD and having ever used emergency contraception or had a sex partner who used emergency contraception. Preliminary analyses indicated that no demographic variables were associated with the outcome variable. Neither ADHD nor CD diagnosis was associated with having used emergency contraception or with having a sex partner who used

emergency contraception. The interaction of ADHD and CD was also not found to be associated with the outcome variable (see Table 3f).

Logistic regression analyses were conducted to examine the association between ADHD diagnosis, CD diagnosis, and the interaction between ADHD and CD and having ever had intercourse resulting in an unintentional pregnancy. Preliminary analyses indicated that clinically significant level scores on the CES-D (i.e. CES-D scores greater than 16) were associated with this outcome variable. In the model that included elevated depression symptoms, ADHD diagnosis, and CD diagnosis, CD was marginally associated with an increased likelihood of having had intercourse resulting in an unintentional pregnancy ( $CI .834 - 151.632$ ,  $p = .06$ ) when controlling for ADHD. Specifically, participants with a CD diagnosis were 11.24 times more likely to have had intercourse resulting in an unintentional pregnancy than their non-disordered peers. When ADHD+CD was added to the model it was not found to be associated with the outcome variable (see Table 3f).

In summary, ADHD was marginally associated with earlier age of first sexual intercourse and with less frequent condom use with a regular sex partner. CD alone was significantly associated with having had a greater number of sex partners and was marginally associated with an increased likelihood of having intercourse resulting in an unintentional pregnancy. The interaction of ADHD and CD was marginally associated with less frequent condom use with a regular sex partner. Although current ADHD medication status was significantly associated with the number of times participants had been diagnosed with an STD and the likelihood of having four or more sex partners,

group comparisons based on medication status among participants with ADHD were nonsignificant.

### *Driving*

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with having driven without a valid license. Preliminary analyses suggested that race, specifically biracial status, and medication status were the only demographic variables significantly associated with driving without a valid license. Biracial status was significantly associated with an increased frequency of driving without a valid license and current use of ADHD medication was associated with a lower frequency of driving without a valid drivers license. In the model that included biracial status, medication status, ADHD, and CD, ADHD was marginally associated with an increased frequency of driving without a valid license ( $\beta = .287, p = .05$ ) when controlling for CD, biracial status, and medication status. CD was also marginally associated with more frequent driving without a valid license ( $\beta = .178, p = .06$ ), when controlling for ADHD, biracial status, and medication status. The model that included these four predictor variables explained 27.5% of the variance. When the interaction term was added to the model, it was not associated with having driven without a valid license (see Table 4).

Given that medication status was significantly associated with the frequency of driving without a valid license, and that only those with ADHD were currently taking ADHD medication, exploratory analyses were conducted to examine group differences

between those with ADHD who were taking medication and those with ADHD who were not taking medication. Differences between these two groups in the frequency of driving without a valid license were nonsignificant.

Next, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of times a driver's license was suspended. Age was the only demographic variable associated with the outcome variable. In the model that included age, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with the outcome variable. When ADHD+CD was added to the model, it was also nonsignificant (see Table 4).

Linear regression analyses were then conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with being cited for failing to stop at a sign or signal. Preliminary analyses suggested that age, Asian race, and Latino or Hispanic race were associated with the outcome variable. Specifically, older age, Asian race, and Latino or Hispanic race were associated with a larger number of citations for failing to stop at a sign or signal. In the model that included these demographic variables, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with number of citations for failing to stop. When the interaction term was added to the model, it was also not associated with the outcome variable (see Table 4).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of car accidents while driving. Preliminary analyses suggested that age,

medication status, and Latino or Hispanic race were significantly associated with being in an accident. Specifically, older age, current ADHD medication use, and Latino or Hispanic race were associated with having been in more accidents while driving. In the model that included these demographic variables, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with having been in an accident while driving. When ADHD+CD was added to the model, it was also nonsignificant (see Table 4).

Given that medication status was associated with the outcome variable, exploratory analyses were conducted to examine group differences in number of accidents while driving between those with ADHD who were taking medication and those with ADHD who were not taking medication. ADHD participants currently taking ADHD medication had been in significantly more accidents while driving than ADHD participants not currently taking ADHD medication ( $t[35] = -2.34, p = .02$ ).

Next, linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of times the participant was found to be at fault for an accident. Preliminary analyses suggested that age and medication status were significantly associated with the outcome variable. Specifically, older age and current ADHD medication use were associated with having been at fault for more accidents. In the model that included these demographic variables, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with having been at fault for an accident. When ADHD+CD was added to the model, it was also nonsignificant (see Table 4).

Exploratory analyses were again conducted to examine group differences between those with ADHD currently taking ADHD medication and those with ADHD not taking

ADHD medication. Differences between the two group in the number of times participants were found to be at fault for an accident were nonsignificant.

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with the number of parking tickets received. Preliminary analyses suggested that none of the demographic variables were associated with the outcome variable. In the model that included ADHD diagnosis and CD diagnosis, ADHD was significantly associated with a greater number of parking tickets ( $\beta = .391, p = .001$ ) when controlling for CD. This model explained 18.2% of the variance. When the interaction term was added to the model, it was also found to be associated with a greater number of parking tickets ( $\beta = .535, p < .05$ ). The final model accounted for 27.9% of the total variance in number of parking tickets received (see Table 4).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with total number of speeding tickets. Preliminary analyses suggested that age and medication status were significantly associated with the outcome variable. Specifically, older age and current ADHD medication use were associated with having received a greater number of speeding tickets. In the model that included age, medication status, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with number of speeding tickets. When ADHD+CD was added to the model, it was also not associated with the outcome variable (see Table 4).

Given that ADHD medication status was significantly associated with number of speeding tickets, exploratory analyses were again conducted to examine group

differences between those with ADHD currently taking ADHD medication and those with ADHD not taking ADHD medication. Differences between the two group in the number of speeding tickets were nonsignificant.

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with being cited for reckless driving. Preliminary analyses suggested that age was associated with having been cited for reckless driving. Specifically, older age was associated with a larger number of citations for reckless driving. In the model that included age, ADHD, and CD, neither ADHD nor CD was associated with number of citations for reckless driving. The interaction of ADHD and CD was also nonsignificant (see Table 4).

Linear regression analyses were conducted to examine the extent to which ADHD diagnosis, CD diagnosis, and the interaction of ADHD and CD were associated with receiving a DUI/DWI. Preliminary analyses suggested that age and Latino or Hispanic race were associated with the outcome variable. Specifically, older age and Latino or Hispanic race were associated with a larger number of DUI/DWI convictions. In the model that included age, Latino or Hispanic race, ADHD diagnosis, and CD diagnosis, neither ADHD nor CD was associated with number of DUI/DWI convictions. The interaction of ADHD and CD was also nonsignificant (see Table 4).

Finally, linear regression analyses were conducted to examine the extent to which ADHD, CD, and the interaction of ADHD and CD were associated with the total number of driving citations received. Preliminary analyses suggested that age, mediation status, and Asian race were associated with total number of citations. Specifically, older age, current ADHD medication use, and Asian race were associated with having received a

greater number of driving citations. In the model that included these demographic variables, ADHD, and CD, ADHD was marginally associated with a greater number of driving citations ( $\beta = .238, p = .06$ ) when controlling for significant demographic variables and CD. This model explained 43.4% of the variance. When ADHD+CD was added to the model, it was also found to be marginally associated with a greater number of driving citations ( $\beta = .294, p = .07$ ). The final model accounted for a sizeable amount of the variance ( 45.6%) in number of driving citations received (see Table 4).

Given that medication status was associated with the outcome variable, exploratory analyses were conducted to examine group differences in total number of driving citations between those with ADHD who were taking medication and those with ADHD who were not taking medication. Among those with ADHD, group differences in total number of driving citations based on ADHD medication status were nonsignificant.

In summary, ADHD was significantly associated with having received more parking tickets relative to those without ADHD. ADHD was marginally associated with driving without a valid license more frequently and with receiving a greater number of driving citations overall relative to those without ADHD. The interaction of ADHD and CD was also marginally associated with receiving a greater number of driving citations relative to those without ADHD. Although current ADHD medication status was often associated with the driving outcome variables, differences among ADHD participants based on current ADHD medication use were largely nonsignificant. One exception was in the number of times participants were involved in a car accident while driving. Here, those with ADHD currently taking ADHD medication were in significantly more



accidents while driving than those with ADHD who were not currently taking ADHD medication.

## Discussion

The present study sought to examine rates of risky behavior among college students with ADHD. While patterns of risky behavior have been studied in adolescents and young adults with ADHD, no published studies of risky behavior have focused on the growing population of college students with this disorder. Overall, the findings from the current study suggest that among college students, ADHD, CD, and their comorbidity are differentially associated with engagement in risky behaviors. Specific associations will be discussed in the ensuing paragraphs. While the results from the present study do support the overarching view that individuals with ADHD engage in higher rates of risky behavior than their non-disordered peers, the specific findings were at times inconsistent with the existing literature on young adults with ADHD.

### *Substance Use*

#### *Tobacco*

Consistent with our predictions and the existing literature, ADHD was associated with a greater likelihood of having ever used tobacco, and marginally associated with higher rates of current tobacco use when controlling for comorbid CD. It has been hypothesized that individuals with ADHD may be self-medicating with nicotine, a stimulant known to improve attention and processing speed (Wilkinson, & Sanberg, 2002). Two previous studies found support for this hypothesis when they examined the effect of nicotine on the clinical severity of ADHD symptoms. Specifically, researchers found that controlled

administration of nicotine significantly reduced the severity of clinical symptoms on the Clinical Global Impressions Scale (National Institute of Mental Health, 1985) and led to significantly improved performance on computerized tests of attention (Conners et al., 2001; Poltavski & Petros, 2006).

### *Alcohol*

In the current study, ADHD was also significantly associated with an increased risk for alcohol dependence relative to college students without ADHD. This increased risk was present even when considering comorbid CD as a control variable. Consistent with studies of young adults with ADHD, college students with ADHD do not consume alcohol in greater quantities or with greater frequency than their non-disordered peers (Weiss & Hechtman, 1993; Wilens, et al., 1998; Wilens, et al., 2002). As noted by Smith, Molina, and Pelham (2002), however, this should not be interpreted as evidence that young adults with ADHD are not consuming alcohol at high rates. Rather, high rates of alcohol consumption are normative at this developmental stage, and young adults with ADHD appear to be “keeping up” with their non-disordered peers. Given this finding, it does not appear to be the *amount* of alcohol consumed by college students with ADHD that puts them at risk for alcohol related problems. However, this population does appear to be vulnerable to developing alcohol *dependence*. For example, in the current study, individuals with ADHD endorsed alcohol-related dependence items on the AUDIT (e.g., “Was unable to stop drinking once started;” “Failed to do what was normally expected from you because of your drinking.”) at significantly higher rates than their peers without ADHD. In contrast to previous studies that linked comorbid CD to the increased rates of alcohol dependence in young adults with ADHD (Barkley et al., 1990; Gittleman et al.,

1985), the present study identified an increased risk for alcohol dependence or emerging dependence in those with pure ADHD (i.e., controlling for CD status). Possible explanations for the difference in findings across studies include: differences in alcohol use assessment methods; differences in sample composition (i.e., mean age of 25 in previous studies versus 20 in the present study); mixed college and non-college young adults in previous studies, in contrast to the current study's exclusive focus on college students living away from their parents; use of clinic-referred samples in previous studies in contrast to a college community sample in the present study; predominately male samples in the previous studies versus a sample with a large proportion of females in the present study; and differences in rates of comorbid CD across studies. Additional studies are needed to determine which, if any, of these factors contribute to the differences in findings.

### *Marijuana*

In the current study, ADHD was also associated with an increased likelihood of having ever used marijuana relative to those without ADHD, when controlling for comorbid CD. Contradictory to our hypothesis, ADHD and the interaction of ADHD and CD was not associated with an increased frequency of current marijuana use or patterns of marijuana use indicative of risk of dependence. In contrast, CD was significantly and uniquely associated with patterns of marijuana use that would indicate dependence risk relative to those without CD, when controlling for ADHD. The absence of an association between level of marijuana use and the interaction of ADHD and CD is surprising given that previous studies of adolescents and young adults (mean age = 20) with ADHD found significantly higher rates of marijuana use among those with ADHD+CD relative to pure

ADHD groups and control groups (Barkley et al., 2004; Molina & Pelham, 2003). Differences in gender composition between the sample in the current study and in previous studies may again provide an explanation. In the current study, level of marijuana use was significantly associated with gender, with females reporting less marijuana use than males. Given that our ADHD sample includes 71% females and that females comprised only 4% (Molina & Pelham, 2003) and 9% (Barkley et al., 2004) of the samples in the two previous studies, gender differences may account, in part, for the discrepancy. A larger sample with a more balanced gender ratio is needed for a thorough examination of gender as a moderator of these results. Another possibility is that the current study was underpowered, and as a result, significant associations between the interaction of ADHD and CD and level of marijuana use could not be detected.

#### *Non-Marijuana Illicit Drugs*

The interaction of ADHD and CD was significantly associated with greater frequency of non-marijuana illicit drug use. This finding is consistent with our hypothesis and with previous studies of primarily male adolescents and young adults which found that those with ADHD+CD displayed the most severe substance use behaviors (Barkley et al., 2004; Molina & Pelham, 2003). The current finding adds to the existing literature in that it is based on a largely female sample drawn exclusively from a college student population. In contrast to our predictions and to results from previous studies, the interaction of ADHD and CD was not significantly associated with a greater likelihood of having ever used non-marijuana illicit drugs or with patterns of use that indicate drug dependence or emerging dependence.

ADHD and CD, when examined independently, were not associated with the likelihood, frequency, or severity of non-marijuana illicit drug use. Although we predicted associations between pure ADHD and non-marijuana illicit drug use, the lack of association is consistent with findings from Barkley's 2004 young adult study and Molina and Pelham's 2003 adolescent study.

#### *Substance Use Summary*

Overall, college students with ADHD appear to be engaging in higher rates of risky substance use behaviors than their non-disordered peers. In the case of alcohol use, pure ADHD appears to confer a risk for alcohol dependence or emerging dependence independent of CD diagnosis. Regarding marijuana use, individuals with ADHD are more likely to have ever used marijuana than their non-disordered peers, although they do not appear to use marijuana with greater frequency than their peers without ADHD. When focusing on non-marijuana illicit drug use, it is the comorbidity of ADHD and CD, rather than pure ADHD, that appears to be associated with the greatest frequency of use. That those with the comorbid diagnoses use what are often considered "hard drugs" (Johnson, et al., 2005) with the greatest frequency is not surprising given that studies have consistently found that among those with ADHD, comorbid CD contributes incrementally to engagement in risky behavior (Barkley, 1991; Molina, Smith, & Pelham, 2003). The specific mechanisms underlying this incremental increase in risky behavior are currently unknown. It has been hypothesized, however, that unique inhibitory deficits (Lynam, 1998; Nigg, 2003) and higher rates of peer rejection (Miller-Johnson, et al., 2002) within this comorbid population may serve as potential mediating factors. Future

research is needed to examine these and other possible mediators of the association between ADHD+CD and substance use behaviors.

### *Risky Sex*

In our examination of associations between ADHD and ADHD+CD and risky sexual behavior, a number of interesting findings emerged. Consistent with our hypothesis, ADHD, when controlling for CD, was significantly associated with higher total scores on a measure of risky sexual behavior, marginally associated with earlier age at first sexual intercourse, and marginally associated with less frequent condom use with a regular sex partner. Also consistent with our predictions and existing studies (Barkley, Fischer, Smallish, & Fletcher, 2005; Flory, et al., 2006), the interaction between ADHD and CD was marginally associated with less frequent condom use with a regular sex partner.

Inconsistent with our hypothesis and with the two existing studies of risky sexual behavior in young adults with ADHD (Barkley, et al., 2005; Flory, et al., 2006), CD, but not ADHD, was significantly associated with a greater number of total sex partners and a greater likelihood of having intercourse that resulted in an unintentional pregnancy. There are a number of possible explanations as to why the findings in the current study differed from those in previous studies. The two existing studies upon which the current hypotheses were based included ADHD samples quite different from the sample in the present study (Barkley, et al., 2004; Flory, et al., 2006). Previous studies included only male, clinic-referred participants who had been followed since childhood through a prospective longitudinal study. In addition, both studies included a mixture of college students and young adults who were not attending college, but did not report having

examined group differences based on college enrollment status. Gender differences in sexual behavior have been widely documented (Gerressu & Stephenson, 2008), as have differences in rates and patterns of risky behavior between young adult college students and young adults not enrolled in college (Hingson, Heeren, Zakocs, Winter, & Wechsler, 2003; Johnson, et al., 2005). Overall differences between clinic and non-clinic referred samples have also been documented, with clinic-referred patients typically presenting more severe symptomatology than those who are non-referred (Goodman, et al., 1997). In addition, differences between young adults with ADHD who were diagnosed and received treatment as children, as was presumably the case for those who participated in longitudinal studies since childhood, and young adults who were potentially undiagnosed or untreated until later in life have not yet been documented in the literature. One can imagine, however, that group differences are likely and therefore, parity between samples drawn from follow-up phases of longitudinal research and cross-sectional samples cannot be assumed. Any one of these differences between the sample in the current study and the samples in previous studies may explain why there are differences in findings. Additional research with larger, more diverse samples, are needed to test for moderators. In addition to sample considerations, another explanation may lie in differences in question format across studies. In the current study, many of the items included in our measure of risky sexual behavior were on the questions used by Barkley and colleagues in his 2004 study. However, questions in Barkley's study were asked in an interview format as opposed to the self-report rating scale format used in the current study. It is possible that this difference in methodology impacted participants' responses. Participants may have been more willing to respond to questions honestly in the paper

and pencil format than in the interview format, leading to biases that either exaggerated or underrepresented true rates of risky sexual behavior. Insufficient statistical power may be another possible explanation for the absence of findings. Controlling for demographic variables associated with the outcome variable may have resulted in the loss of power needed to detect associations that may not have been as large as those in the area of substance abuse. Finally, it is possible that the sexual practices of college students with ADHD differ significantly from the sexual practices of young adults with ADHD who are not attending college. Given that no previous studies have examined sexual behaviors in college students with ADHD, we are not able to compare our results to an existing study with a comparable sample.

In summary, the current study shows that ADHD is marginally, and in one instance, significantly, associated with higher rates of certain risky sexual behaviors in a largely female sample of college students with ADHD. Additional studies with larger sample sizes are needed to determine whether the trends identified in the current study achieve significance when adequate statistical power is assured, and to study the role of possible moderators such as gender and college enrollment status.

### *Driving*

In our examination of driving behaviors, the prediction that ADHD and the interaction of ADHD and CD would be associated with riskier driving behaviors was partially supported. ADHD was significantly associated with higher rates of driving without a valid license and with receiving more parking tickets in comparison to those without ADHD. In addition, ADHD and the interaction of ADHD and CD were marginally associated with receiving a greater total number of driving citations. Contrary



to the predictions made in the current study, and to findings in previous studies conducted with adolescents and young adults with ADHD (Barkley, 2004b; Barkley, et al., 1993; Barkley, Murphy, et al., 2002), individuals with ADHD had not received more speeding tickets, were not involved in more car accidents when driving, were not determined to be at fault for more accidents, did not receive more DUI/DWI convictions, and were not cited for reckless driving more often than their non-disordered peers. There are a number of possible explanations for the differences between the findings of the current study and those of previous studies. First, it is likely that the driving patterns (frequency, distance, duration) of college students living on or near campus differ significantly from the driving patterns of non-college students or college students who commute to campus. The fact that the only driving-related infraction that significantly differentiated participants with ADHD from those without ADHD was the number of parking tickets received may be a testament to this difference in driving patterns. In addition, while participants were asked to estimate the number of hours driven weekly, they were not asked whether or not they had access to a car during the school year. Second, the power limitations noted previously apply to the analyses of driving behaviors as well.

In summary, the current study shows that college students with ADHD receive significantly more parking tickets than their non-disordered peers. In addition, marginally significant associations were found between pure ADHD as well as ADHD with comorbid CD and a greater number of driving citations. Additional studies of college students with ADHD are needed to expand upon these findings.

### *Summary*

The current study is the first to examine risky behaviors in college students with ADHD, and is the first to include a large proportion of females in a study of risky behavior and ADHD. The study's findings indicate that college students with ADHD are at increased risk for a number of problems related to substance use, sexual behavior, and driving. Specifically, college students with ADHD are at increased risk for alcohol dependence, and those with comorbid conduct disorder are at increased risk for non-marijuana illicit substance use. In the current study a trend emerged for higher rates of risky sex practices among those with ADHD, and, more specifically, for less frequent condom use with regular sex partners. While in significant associations between ADHD and risky driving habits were not present, individuals with ADHD did receive significantly more parking tickets than their non-disordered peers.

The current study has a number of limitations. First, the size of the present sample may not be large enough to detect the predicted associations and to justify the numerous associations tested. Typically at least one, and often multiple, demographic variables were controlled for in each analysis further limiting the statistical power. Second, the ADHD sample was 71% female and the non-ADHD sample 51% female. This gender imbalance may not represent the true gender ratio among college students with ADHD and it makes comparisons with previous studies, which typically included only male participants, challenging. On the other hand, studies of females with ADHD are sorely lacking in the existing literature. In this regard, the current study begins to fill a gap in the literature that has not yet been addressed. Third, the current study does not include a non-college student ADHD group. Thus, while we can discuss whether or not differences between findings in the current study and in previous studies may be due to

differences between college students with ADHD and their young adults with ADHD who are not attending college, we cannot draw any conclusions in the absence of a non-disordered comparison group. Finally, the current study was conducted at a large, public, Mid-Atlantic university with stringent admissions criteria. Results of the current study can only be generalized to students with ADHD attending universities with similar characteristics.

Future studies of risky behavior in young adults and college students with ADHD are needed to address the limitations of the existing study. Specifically, future studies should include larger samples comprised of both males and females, age- and demographically-matched students at a variety of post-secondary institutions, and young adults who are not attending college. These study characteristics will allow for the examination of potential moderators, such as gender and college enrollment status, and will further our understanding of the associations between ADHD and risky behaviors. Finally, given the significant associations between ADHD and risky behaviors, prevention and intervention measures, particularly those related to alcohol and illicit substance use, need to be developed and studied specifically in samples of college students with ADHD.

Table 1  
Demographic and Diagnostic Characteristics

Characteristic	Non-ADHD	ADHD
	<i>n</i> = 60 <i>N</i> (%)	<i>n</i> = 39 <i>N</i> (%)
Age ( <i>M</i> , <i>SD</i> )	19.7 (.751)	20.3 (1.594)*
Year in School ( <i>M</i> , <i>SD</i> )	15.8 (.691)	14.7 (.887)
Fraternity or Sorority Member	18 (30.0)	15 (38.5)
Sex		
Male	29 (48.3)	11 (28.2)
Female	31 (51.7)	28 (71.8)
Race/Ethnicity		
Non-Hispanic White	43 (71.7)	31 (79.5)
African American	7 (11.7)	0 (0.0)
Latino or Hispanic	3 (5.0)	3 (7.7)
Asian	6 (10.0)	2 (5.1)
Biracial	1 (1.7)	3 (7.7)
DSM-IV Diagnoses		
Conduct Disorder	4 (6.7)	10 (25.6)
Learning Disability	4 (6.7)	7 (17.9)
ADHD Medication - current	0 (0.0)	25 (64.1)

Note. DSM-IV = Diagnostic and Statistical Manual, Fourth Edition. ADHD=Attention-Deficit/Hyperactivity Disorder. \* denotes  $p < .05$

Table 2a  
Percentage of Participants that have Ever Used Following Substances, Odds Ratios, and 95% Confidence Intervals

Drug	Comparison (n=56)	ADHD Only (n=29)	CD Only (n=4)	ADHDxCD (n=10)
Tobacco	48.2%	69% OR=2.46 (CI=.977-6.295) <sup>+</sup>	50% OR=1.81 (CI=.407-8.087)	90% OR=2.129 (CI=.093-48.742)
Marijuana	46.4%	79.3% OR=3.419 (CI=1.139-10.261)*	100% OR=.2E+009 (CI=.000)	100% OR=.131 (CI=.000)
Non-Marijuana	23%	34.5% OR = 1.555 (CI=.563-4.301)	0% OR=.000 (CI=.000)	70% OR=1E+009 .000

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. <sup>+</sup> denotes  $p < .01$ . \*denotes  $p < .05$ .

Table 2b  
 Frequency of substance use over the past 30 days

	Tobacco						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig.</i>	<i>SE</i>	$\beta$
Step 1	1, 97	5.625	.055	.055	.020		
Age						.144	.234
Step 2	3, 95	3.467	.099	.044	.019		
ADHD						.362	.217*
CD						.513	-.005
Step 3	4, 94	2.581	.061	.000	.042		
ADHDxCD						1.092	.033
	Marijuana						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig.</i>	<i>SE</i>	$\beta$
Step 1	2, 96	.599	.012	.012	.552		
ADHD						.325	-.047
CD						.456	.114
Step 2	3, 95	.869	.027	.014	.460		
ADHDxCD						.965	.228
	Non-Marijuana Illicit Drugs						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig.</i>	<i>SE</i>	$\beta$
Step 1	2, 96	3.003	.059	.059	.059		
ADHD						.196	.025
CD						.274	.235*
Step 2	3, 95	3.571	.101	.042	.020		
ADHDxCD						.571	.392*

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
 ADHDxCD=ADHD with comorbid CD. \* denotes  $p < .05$ .

Table 2c  
AUDIT Total Score and Subscores

	Total						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Fraternity-Sorority Membership	1, 97	6.433	.062	.062	.013	6.33	.249
Step 2 ADHD	3, 95	4.297	.119	.057	.007	1.326	.221*
CD						1.859	.052
Step 3 ADHDxCD	4, 94	3.337	.124	.005	.013	6.215	.133
	Quantity-Frequency						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Fraternity-Sorority Membership	1, 97	6.727	.065	.065	.011	.584	.255
Step 2 ADHD	3, 95	2.838	.082	.017	.042	.270	-.120
CD						.816	.034
Step 3 ADHDxCD	4, 94	2.465	.095	.013	.050	1.698	.210
	Dependence or Emerging Dependence						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Fraternity-Sorority Membership	1, 97	11.804	.108	.062	.001	.101	.329
Step 2 ADHD	3, 95	7.310	.188	.057	.000	.098	.227*
CD						.118	.222
Step 3 ADHDxCD	4, 94	5.472	.189	.005	.001	.293	.069
	Alcohol Related Harm						
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Fraternity-Sorority Membership	1,97	12.98	.118	.118	.000	.097	.344
Step 2 ADHD	3,95	6.095	.161	.043	.001	.096	.149
CD						.134	.113
Step 3 ADHDxCD	4,94	4.530	.162	.000	.002	.286	.027

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. \* denotes  $p < .05$ .

Table 2d  
DUDIT-Marijuana Total Score

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	1, 97	5.617	.055	.055	.020		
Gender						1.046	-.234
Step 2	3, 95	4.637	.128	.073	.005		
ADHD						1.076	.121
CD						1.485	.215*
Step 3	4, 94	3.935	.143	.016	.005		
ADHDxCD						3.146	.239

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. \* denotes  $p < .05$ .

Table 2e  
DUDIT-Non-Marijuana Illicit Drugs Total Score

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	2, 96	1.434	.029	.029	.234		
ADHD						6.331	.110
CD						.888	.104
Step 2	3, 95	1.78	.053	.024	.157		
ADHDxCD						.295	.123

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD.

Table 3a  
Age at First Sexual Intercourse

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	1, 97	5.848	.057	.057	.017		
Age						.209	.240
Step 2	3, 95	3.050	.089	.031	.032		
ADHD						.531	.178 <sup>+</sup>
CD						.751	-.092
Step 3	4, 94	2.758	.106	.017	.032		
ADHDxCD						1.582	-.257

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. <sup>+</sup> denotes  $p < .01$ .

Table 3b  
Number of Sex Partners

Penetrative Sex Partners							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Age	1, 97	5.732	.056	.056	.019	.074	.236
Step 2 ADHD CD	3, 95	2.047	.061	.005	.112	.189 .268	.028 .061
Step 3 ADHDxCD	4, 94	1.528	.061	.000	.200	.570	-.036
Both Penetrative and Non-Penetrative Sex Partners							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 ADHD CD	2, 96	3.131	.063	.043	.048	.677 .942	.076 .221*
Step 2 ADHDxCD	3, 95	3.049	.090	.061	.033	1.980	.314

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
ADHDxCD=ADHD with comorbid CD. \* denotes  $p < .05$ .

Table 3c  
Frequency of Condom Use

Regular Sex Partner							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 Gender	1, 97	4.194	.041	.041	.043	.350	-.154
Step 2 ADHD CD	3, 95	3.498	.099	.058	.019	.363 .501	.203+ .096
Step 3 ADHDxCD	4, 94	3.523	.130	.031	.010	1.053	.336+
Casual Sex Partner							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1 ADHD CD	2, 96	.066	.001	.001	.936	.198 .278	-.023 -.220
Step 2 ADHDxCD	3, 95	.048	.001	.000	.986	-.021	-.110

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
ADHDxCD=ADHD with comorbid CD. + denotes  $p < .01$



Table 3d  
Number of STD Diagnoses

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	SE	$\beta$
Step 1	2, 92	8.560	.139	.157	.000		
Age						.016	.324
Medication Status						.044	.186
Step 2	4, 90	4.604	.170	.013	.002		
ADHD						.058	-.127
CD						.058	-.069
Step 3	5, 89	3.698	.172	.002	.004		
ADHDxCD						.123	-.090

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
ADHDxCD=ADHD with comorbid CD. STD=Sexually transmitted disease.

Table 3e  
Number of Times Tested for HIV

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	SE	$\beta$
Step 1	1, 98	6.114	.059	.059	.015		
Age						.226	.243
Step 2	3, 95	3.316	.095	.036	.023		
ADHD						.571	.175 <sup>+</sup>
CD						.808	.056
Step 3	4, 94	2.647	.063	.006	.038		
ADHDxCD						1.715	.157

ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
ADHDxCD=ADHD with comorbid CD. HIV=Human Immunodeficiency Virus.

<sup>+</sup> denotes  $p < .01$ .

Table 3f  
Percentage of Participants Engaging in Risky Sexual Behavior or Experiencing Negative Consequences, Odds Ratios, and 95% Confidence Intervals

<b>Risky Sexual Behavior</b>	<b>Comparison (n=56)</b>	<b>ADHD Only (n=29)</b>	<b>CD Only (n=4)</b>	<b>ADHDxCD (n=10)</b>
Ever	1.8%	3.4%	25%	10%
Unintentional Pregnancy		OR= 1.395 (CI .101-19.329)	OR=11.247 (CI .834-151.632) <sup>+</sup>	OR= .000 (CI .0000)
Ever Used Emergency Contraception	23.2%	27.6% OR=.762 (CI .301-1.908)*	50% OR=1.080 (CI .141-8.257)	40% OR=1.312 (CI .108-15.885)
Had 4 or more sex partners (lifetime)	25%	31% OR=.983 (CI .394-2.773)	25% OR=.619 (CI .059-6.521) <sup>+</sup>	70% OR=7.120 (CI .419-121.041)

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder.  
ADHDxCD=ADHD with comorbid CD.

Table 3g  
Risky Sexual Behavior Composite Score (from HRBS)

	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	1,93	6.397	.064	.064	.013		
Age						.093	.254
Step 2	3,91	2.252	.069	.005	.088		
ADHD						.240	.068
CD						.336	-.039
Step 3	4,90	1.726	.071	.002	.151		
ADHDxCD						.717	-.090

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. HRBS=HIV Risk Behavior Survey.

Table 4  
Frequency of Driving Violations and Citations

Driven without a Valid License							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	3, 90	7.782	.206	.206	.000		
Biracial						1.404	.443
Medication Status						.558	-.187
Step 2	5, 88	6.691	.275	.069	.000		
ADHD						.770	.287 <sup>+</sup>
CD						.713	.178 <sup>+</sup>
Step 3	6, 87	6.051	.294	.019	.000		
ADHDxCD						1.471	.256
Had License Suspended							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	2, 94	10.016	.179	.179	.000		
Age						.003	-.038
Step 2	4, 90	6.481	.224	.045	.000		
ADHD						.063	.151
CD						.088	.129
Step 3	5, 89	5.336	.231	.007	.000		
ADHDxCD						.164	.901
Cited for Failing to Stop at a Signal							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	4, 90	6.951	.236	.236	.000		
Age						.047	.229
Asian						.213	.315
Latino or Hispanic						.229	.247
Step 2	6, 88	4.836	.248	.012	.000		
ADHD						.121	.076
CD						.168	.069
Step 3	7, 87	4.225	.254	.006	.000		
ADHDxCD						.359	.150

Table 4 continued

Been in an Accident While Driving							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	4, 90	9.198	.290	.290	.000		
Age						.129	.218
Latino or Hispanic						.630	.269
Medication Status						.351	.338
Step 2	6, 88	6.582	.310	.020	.000	.482	-.001
ADHD						.456	.148
CD							
Step 3	7, 87	5.828	.319	.009	.000	.965	.191
ADHDxCD							
Determined to be at Fault for an Accident							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	4, 90	9.198	.290	.290	.000		
Age						.129	.218
Latino or Hispanic						.630	.269
Medicatio n Status						.351	.338
Step 2	6, 88	6.582	.310	.020	.000	.482	-.001
ADHD						.456	.148
CD							
Step 3	7, 87	5.828	.319	.009	.000	.965	.191
ADHDxCD							
Parking Tickets							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	2, 90	11.264	.182	.200	.000		
ADHD						2.627	.135
CD						3.596	.391*
							*
Step 2	3, 89	11.486	.279	.079	.000	7.262	.535*
ADHDxCD							
Speeding Tickets							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1			.348	.348	.000		
Age						.107	.489
Medication Status						.289	.270
Step 2			.352	.004	.000	.412	.042
ADHD						.391	-.067
CD							
Step 3			.352	.000	.000	.824	-.039
ADHDxCD							

Table 4 continued

Citations for Reckless Driving							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	2, 94	6.949	.131	.131	.002		
Age						.020	.365
Step 2	4, 90	4.259	.159	.028	.003		
ADHD						.051	.027
CD						.071	.116
Step 3	5, 89	3.848	.178	.019	.003		
ADHDxCD						.149	.267
DUI/DWI Convictions							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	3, 91	14.056	.317	.317	.000		
Age						.022	.519
Latino or Hispanic						.107	.188
Step 2	5, 89	8.726	.329	.012	.000		
ADHD						.056	.104
CD						.078	.032
Step 3	6, 88	7190	.329	.000	.000		
ADHDxCD						.167	-.005
Total Driving Citations							
	<i>df</i>	<i>F</i>	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> $\Delta$	<i>Sig</i>	<i>SE</i>	$\beta$
Step 1	4, 86	13.656	.388	.388	.000		
Age						.422	.537
Medication Status						1.099	.537
Asian						1.793	.259
Step 2	6, 84	10.746	.434	.046	.000		
ADHD						1.444	.238 <sup>+</sup>
CD						1.402	.141
Step 3	7, 83	9.923	.456	.021	.000		
ADHDxCD						2.935	.294 <sup>+</sup>

Note: ADHD=Attention-Deficit/Hyperactivity Disorder. CD=Conduct Disorder. ADHDxCD=ADHD with comorbid CD. DUI/DWI=Driving Under the Influence/Driving While Intoxicated. <sup>+</sup> denotes  $p < .01$ . \* denotes  $p < .05$ . \*\* denotes  $p < .001$ .

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