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Pathways to Substance Use and Sexual Risk Behavior Among College Students with ADHD Symptomatology

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PATHWAYS TO SUBSTANCE USE AND SEXUAL RISK BEHAVIOR AMONG COLLEGE

STUDENTS WITH ADHD SYMPTOMATOLOGY

BY

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OF

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ABSTRACT

While growing numbers of students with attention deficit hyperactivity disorder (ADHD) symptomatology are pursuing postsecondary education, there is a dearth of information concerning the social functioning of these students. ADHD symptomatology has been strongly linked with risk behaviors that contribute to chronic health problems, including substance use and risky sexual behavior, resulting in twice the health care costs for these students in the United States. Despite such critical findings, specific pathways between ADHD and substance use and sexual risk, have not been identified. A large body of literature has demonstrated that individuals with ADHD are at greater risk for developing externalizing behavior problems, which in turn appear to predict substance use and sexual risk behavior. Evidence also suggests that individuals with ADHD symptomatology often exhibit executive function (EF) deficits, and several studies have linked executive dysfunction to substance use problems and sexual risk behavior. Therefore, the purpose of the present study was to: a) examine the relationship among ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior among N=411 college students; b) propose and test three nested, latent variable models (i.e., a mediation, full, and a direct effects model) and identify significant paths between the variables; and c) examine the three latent variable models and determine which model best represents the relationship between the variables.

Overall, results revealed significant correlations among ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior. While the mediation and full models demonstrated specficiation

errors that could not be resolved into meaningful solutions, significant pathways were identified within the direct latent variable model, including paths between ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior, respectively. Furthermore, the direct model proved to best represent the data, over and above the two other latent variable models.

The present findings have implications for public health policy, particularly as it relates to the college population. Limitations of the study and suggestions for future research are discussed.

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PREFACE

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Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a chronic neurodevelopmental disorder, characterized by clinically significant symptoms of inattention, hyperactivity, and impulsivity, affecting approximately 2-7% of individuals in the United States (American Psychiatric Association, 2013). ADHD has been associated with significant difficulties in psychosocial and academic adjustment, including disruptive behavior, lower grade point averages, academic underachievement, school dropout, and higher rates of comorbid psychopathology (American Psychiatric Association, 2013; Barkley, 2008; Bussing, Mason, Bell, Porter, & Garvan, 2010). Despite these increased risks, recent research has found that increasing numbers of high school students with ADHD are pursuing higher education (Weyandt & DuPaul, 2013; Wolf, Simkowitz, & Carlson, 2009). Although the exact prevalence of the disorder in the college population is unknown, a recent national survey indicates that approximately 6% of first-year college students report being diagnosed with ADHD (Eagan et al., 2014). Weyandt and DuPaul (2013) emphasized the dearth of information available and stressed the need for studies to explore the prevalence, nature, and academic and social functioning of college students with ADHD.

ADHD has been associated with risk behaviors that contribute to chronic health problems, including substance use and risky sexual behavior (Flory, Molina, Pelham, Gnagy, & Smith, 2006; Harty, Galanopoulos, Newcorn, & Halperin, 2013; Schoenfelder & Kollins, 2015). Young people with ADHD, for example, have twice the health care costs in the United States (Leibson, Katusic, Barbaresi, Ransom, & O'Brien, 2001) and increased mortality rates compared to those without the disorder (Dalsgaard, Ostergaard,

Leckman, Mortensen, & Pedersen, 2015). Despite such critical findings, specific pathways between ADHD and substance use and sexual risk, have not been identified (Flory et al., 2006; Molina & Pelham, 2014). A large body of literature, however, has demonstrated that children and adolescents with ADHD are at a greater risk for developing behavior problems, including oppositional defiant disorder (ODD) and conduct disorder (CD; Barkley, Murphy, & Fischer, 2008), which in turn appear to predict substance use (Zucker, 2006) and risky sexual behavior (Flory et al., 2006). Evidence also suggests that individuals with ADHD are more likely to display impaired executive functions (EF) i.e., cognitive abilities that allow for self-regulation and inhibitory control (Barkley 2012; Weyandt et al., 2014). Several studies have reported that executive dysfunction increases the risk for substance use among adolescents (Aytaclar, Tarter, Kirisci, & Lu, 1999; Tarter et al., 2003), young adults (Deckel & Hesselbrock, 1996) and college student populations (Huggins, Rooney, Chronis-Tuscano, 2015), although other studies have not supported these findings (e.g., Wilens et al., 2011). Difficulties with impulsivity in conjunction with EF deficits have also been associated with greater sexual risk behavior (Barkley et al., 2008; Quinn & Fromme, 2010). In summary, although research has identified ADHD symptomatology, externalizing symptomatology, and EF deficits as increasing the risk for substance use and sexual risk behavior, to date no studies have systematically examined potential pathways between these variables. The present study addressed this void in the literature by proposing and testing three latent variable models concerning the relationship between ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior, in a sample of college students with and without ADHD symptomatology.

Specifically, it was hypothesized that a) ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would be significantly correlated (see Appendix A for a more detailed description of the variables of interest), b) a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would demonstrate statistically significant paths between the independent variables, mediators, and dependent variables, c) a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would best represent the relationship between the variables, over and above two other nested, latent variable models (i.e., a full model and a direct effects model). Specifically, goodness of fit indices were hypothesized to be strongest for the mediational model relative to the full and direct effects models.

ADHD Symptomatology and Substance Use

Substance use disorders are health outcomes well recognized to co-occur with ADHD. For example, adults with ADHD have been found to use alcohol and other drugs at higher rates than those in the general population (Lee, Humphreys, Flory, Liu, & Glass, 2011). Indeed, an estimated 15.2% of adults with ADHD meet criteria for a substance use disorder, a rate that is almost three times greater than among adults without ADHD (Kessler et al., 2006). A recent meta-analysis documented that one in four substance dependent persons had an ADHD diagnosis during their lifetime (van Emmerik-van Oortmerssen et al., 2012), while another study by Lee and colleagues (2011) suggested that youth with ADHD have at least 1.5 times the average risk of developing dependence on nicotine, alcohol, marijuana, cocaine, and other drugs.

Interestingly, young adult ADHD research has yielded mixed results with regard to the relationship between ADHD and substance use problems. Some studies have documented that young adults with ADHD tend to report higher rates of underage consumption of alcohol, marijuana use, and experimentation with other illicit drugs compared to their non-ADHD peers (Bidwell, Henry, Willcutt, Kinnear, & Ito, 2014; Dunne, Hearn, Rose, & Latimer, 2014; Langley et al., 2010; Lee et al., 2011), in addition to a faster progression and less odds at recovering from substance use disorders (Fuemmeler, Kollins, & McClernon, 2007; Molina et al., 2009). Additionally, Upadhyaya and Carpenter (2008) reported a positive correlation between ADHD symptom severity and alcohol and marijuana use among a group of young adults. Likewise, Upadhyaya et al. (2005) found that college students with ADHD had more past-year tobacco and marijuana use than their peers. Alternatively, other research has demonstrated little to no alcohol or substance use differences between young adults with and without ADHD (Baker, Prevatt, & Proctor, 2012; Bussing et al., 2010; Rabiner, Anastopoulos, Costello, Hoyle, & Swartzwelder, 2008). For example, Rabiner and colleagues (2008) found that students with past or current ADHD were not more likely than other college students to report consuming alcohol. Likewise, Baker and colleagues (2012) reported no illicit substance use differences among college students with and without ADHD. While research linking ADHD and substance use in college students is inconsistent, perhaps discrepant findings are due to the lack of thoroughly confirmed ADHD diagnoses within the samples. The present study, however, implemented comprehensive clinic-based ADHD criteria and rigorous methodological strategies, and may therefore help address the inconsistent findings in the literature.

While it remains unclear whether young adults with ADHD consume more alcohol and take part in greater rates of substance use compared to their non-ADHD peers, several studies have suggested that college students with ADHD engage in more problematic drinking behaviors, resulting in greater alcohol-related consequences (Baker et al., 2012; Glass & Flory, 2012; Lee et al., 2011; Rooney, Chronis-Tuscano, & Huggins, 2012; Rooney, Chronis-Tuscano, & Yoon, 2011; Wilens & Biederman, 2006). More specifically, studies report that college students with ADHD are more likely than their peers to have difficulty limiting their alcohol consumption, consume alcohol until they "black out", drive under the influence of alcohol or illicit substances, experience injuries resulting from fights while under the influence, and have more alcohol-related conflict with their significant other (Baker et al., 2012; Glass & Flory, 2012; Lee et al., 2011; Rooney et al., 2012; Wilens & Biederman, 2006). Research also suggests that increased alcohol use among college students with ADHD is linked to greater impairment in daily activities, social relationships, and sexual interactions (Langberg, Dvorsky, Kipperman, Molitor, & Eddy, 2014).

In summary, empirical evidence suggests that college students with ADHD symptomatology are at elevated risk for negative health consequences associated with substance use, and greater research is needed to develop effective substance use prevention and intervention programs. In particular, research is needed to identify the specific factors that predict substance use in college and the potential mediators in such relationships that, in turn, could be targeted via prevention and intervention.

ADHD Symptomatology and Sexual Risk Behavior

Although studies examining the effects of ADHD on risky sexual behavior are generally lacking, preliminary data suggest that individuals with ADHD lead higher-risk sexual lifestyles (Brown et al., 2010; Flory et al., 2006; Hosain, Berenson, Tennen, Bauer, & Wu, 2012; Nigg, 2013). For example, in the Milwaukee Young Adult Outcome Study, Barkley (2006) reported that young adults with ADHD tended to have sexual intercourse at an earlier age, had more sexual partners, used less contraception, which may lead to teen pregnancy and sexually transmitted infections (STIs). By the time adolescents in the study turned 20, the ratio of births by the ADHD group to the control was 42:1 (Barkley, 2006). Flory and colleagues (2006) found similar results among a group of young men with ADHD who reported a number of unsafe sexual behaviors including earlier debut of sexual activity and intercourse, an increased number of sexual partners, and more casual sex. Male students with ADHD were also less likely to use contraception, resulting in greater rates of STIs and partner pregnancies (Flory et al., 2006).

More recently, a retrospective study of college students found that women with ADHD reported more unprotected sex not only than women without ADHD but also more so than men on average (Huggins, Rooney, and Chronis-Tuscano, 2015). Hosain and colleagues (2012) also found that young adult women with ADHD symptomatology reported risky sexual behaviors, including sex before 15 years of age, more risky sexual partners in their lifetime, greater numbers of sex partners in the last 12 months, less condom use in the last 12 months, alcohol use before sex in the last 12 months, having traded sex in their lifetime, and having been diagnosed with sexually transmitted infection (STI) in their lifetime.

In summary, while preliminary evidence suggests that both college student men and women with ADHD are at elevated risk for the negative health consequences associated with risky sexual behavior (e.g., sexually transmitted infections), more research is needed to better understand the specific factors that predict different types of risky sexual behavior in addition to potential mediator variables. Such research would substantially aid future health promotion efforts.

Externalizing Symptomatology and Substance Use

The externalizing pathway is theorized to begin with childhood externalizing symptomatology (e.g., aggression and conduct problems), early onset substance use, increases in antisocial behavior, and the eventual onset of Substance Use Disorders (SUDs; Tarter et al., 2003; Zucker et al., 2006). Externalizing symptoms, therefore, reflect behavioral disinhibition, also referred to as the inability to inhibit undesirable or restricted behaviors (Iacono, Malone, & McGue, 2008). In fact, current risk models suggest that underlying deficits in behavioral inhibition and a high-risk environment may place children at most risk for externalizing behaviors (e.g., Hussong, Curran, & Chassin, 1998; Zucker et al., 2006). Children with ADHD, therefore, may be at greater risk for externalizing symptomatology given that behavioral disinhibition is a core deficit of the disorder (Weyandt & DuPaul, 2006). Indeed, disruptive behavior disorders, such as Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD), are especially common comorbid conditions in children and adolescents with ADHD (Fischer, Barkley, Smallish, & Fletcher, 2002).

Externalizing symptoms are consistently positively correlated with substance use in adolescence and young adulthood (Hawkins, Catalano, & Miller, 1992; Hussong et al.,

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1998; King, Iacono, & McGue, 2004; Zucker, 2006). In the Minnesota Twin Family Study, externalizing psychopathology predicted experience with alcohol, nicotine and cannabis by age 14, as well as regular and advanced experience with these substances (King et al., 2004). Another study monitored children with ADHD and ODD/CD through adolescence, and found that ODD/CD symptoms were predictive of illicit drug use and CD symptoms in adolescence (Molina & Pelham, 2003). In the same study, children with ADHD reported greater alcohol symptom scores, with childhood inattentive symptom severity being the most predictive of several negative substance use outcomes (Molina & Pelham, 2003). Furthermore, persistence of ADHD and adolescent CD were each associated with elevated substance use behaviors relative to controls (Molina & Pelham 2003). Other studies examining adults with ADHD demonstrate the rate of comorbid conditions, including substance use disorders and antisocial personality disorder (Barkley et al., 2008; Biederman, Petty, Evans, Small, & Faraone, 2010; Garcia et al., 2012). Interestingly, a behavioral genetics study suggested that disruptive disorder symptoms (i.e., ODD/CD) and substance use may share a common genetic predisposition for disinhibited behavior (Iacono et al., 2008). Collectively, these studies suggest the externalizing pathway may indeed be the primary pathway of risk for the development of SUDs.

Externalizing Symptomatology and Sexual Risk Behavior

Similar to substance use, externalizing symptomatology has been associated with risky sexual behavior (Barkley, 2006; Brown et al., 2010; Sarver, McCart, Sheidow, & Letourneau, 2014). For example, Brown and colleagues (2010) reported that adolescents meeting criteria for an externalizing disorder (i.e., ODD, CD, and ADHD) were

significantly more likely to report a lifetime history of vaginal or anal sex. Furthermore, in a sample of adolescents, the relationship between ADHD symptoms and risky sexual behavior emerged only among youth with clinically elevated conduct problems and problematic marijuana use (Sarver et al., 2014), suggesting that early identification and treatment of such conditions may be important for sexual risk prevention. Longitudinal studies have demonstrated that a childhood history of disruptive behaviors is associated with early initiation of intercourse and greater rates of adolescent sexual activity among boys (Barkley, 2006; Ramrakha et al., 2007), and early initiation of intercourse, multiple sex partners, and increased rates of teen pregnancies among adolescent girls (Ramrakha et al., 2007). This line of research has important implications for sexual risk prevention, with accumulating evidence demonstrating support for prevention and treatment programs that address deficits or introduce protective factors important in decreasing externalizing behaviors (e.g., Cutuli et al., 2013; Lochman, Powell, Boxmeyer, & Jimenez-Camargo, 2011).

Executive Function Deficits and Substance Use

Executive functioning is a multifaceted construct that has often been defined as the higher-order cognitive abilities that underlie self-regulation, impulse control, decision-making, strategic planning, cognitive flexibility, and goal-directed behavior (Weyandt, 2005; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Although EF deficits are not characteristic of all individuals with ADHD, as noted by Weyandt (2009), a substantial body of research has found that individuals with ADHD often exhibit executive function deficits (Barkley 2012; Murphy, Barkley, & Bush, 2001; Nigg et al., 2006; Weyandt, 2009; 2014). For over two decades, deficits in EF have been linked to

substance use behaviors (Molina & Pelham, 2003). Such difficulties may begin at an early age, with childhood EF deficits identified as a predictor of drug use in early adolescence (Tarter et al., 2003). Self-regulation (Quinn & Fromme, 2010) and impulse control (i.e., behavioral disinhibition; Nigg et al., 2006) deficits, in particular, have been the major focus of substance use research examining EF.

Poor self-regulation, one underlying construct of EF, is among the strongest personality predictors of alcohol use (Hittner & Swickert, 2006; Hustad, Carey, Carey, & Maisto, 2009; Quinn & Fromme, 2010) and such findings have been replicated among college student samples. For example, Gottfredson and Hussong (2013) examined the role of affective self-regulation on alcohol use, and found that poor self-regulation was predictive of increased drinking frequency and higher levels of self-reported drinking to cope their affect variability. Alternatively, students with high self-regulation inversely predicted heavy episodic drinking and alcohol-related problems (Fromme & Quinn, 2010). Interestingly, difficulties with behavioral self-regulation have been linked to marijuana use, while emotional self-regulation deficits have been predictive of marijuana-related problems (Dvorak & Day, 2014). Perhaps, behavioral self-regulation difficulties place college students at risk for substance use while emotional self-regulation places them at risk for the negative consequences resulting from their substance use.

In addition to self-regulation, difficulties with impulse control have been linked to substance use (Dvorak & Day, 2014). Tarter and colleagues (2003) identified behavioral disinhibition as a stronger predictor of substance use disorders in young adulthood, over and above teenage substance use. In a study of young adults (i.e., 21.1-22.3 years of age)

diagnosed with ADHD compared to nonclinical controls, three dimensions of impulse control (i.e., attentional inhibition, response inhibition, and sensation seeking) were predictive of self-reported alcohol use (Weafer, Milich, & Fillmore, 2011). Attentional inhibition, in particular, predicted alcohol consumption in the ADHD group, suggesting that specific types of behavioral disinhibition may contribute to elevated rates of substance use among individuals with ADHD (Weager et al., 2011). In a related study by Rooney and colleagues (2012), impulse control deficits accounted for heightened rates of alcohol use among college students diagnosed with ADHD. College students with EF deficits may take part in greater substance use, and despite the need for work in this area, very few studies have examined the relationship between EF and substance use.

Executive Function Deficits and Sexual Risk Behavior

Similar to the literature examining the relationship between EF and substance use, self-regulation and impulse control have been the major focus of research linking EF deficits to sexual risk behavior (Crockett, Raffaelli, & Shen, 2006; Epstein et al., 2014; Moilanen, 2015; Raffaelli & Crockett, 2003; Quinn & Fromme, 2010). Raffaelli and Crockett (2003) demonstrated an association between self-regulatory skills in early adolescence and risky sexual behavior in late adolescence among a national sample of boys and girls. More recently, college students with high self-regulation inversely predicted sexual risk behavior (e.g., unprotected sex), even when controlling for gender and risk factors (Fromme & Quinn, 2010). In yet another study, Moilanen (2015) found that young adults with long-term self-regulation skills reported fewer sexual risk behaviors including later initiation of oral sex and coitus, fewer lifetime coital partners, increased likelihood of condom and other contraceptive use at last intercourse, and low

levels of coitus risk, while participants with short-term self-regulatory skills reported a reduced likelihood of condom use and greater overall coital risk. While deficits in self-regulation have been linked to risky sexual behaviors, a major limitation of studies includes the various ways in which self-regulation and its associated components are identified, defined, and measured (Berger, 2011). For example, previous research has coined several different terminologies (e.g., self-control, vigilance, inhibition) to refer to similar components that overlap with one another (Berger, 2011; Moilanen, 2015; Muraven & Baumeister, 2001). To account for this issue, the present study implemented a broader conceptualization of executive function, and in doing so incorporates overlapping subcomponents such as self-regulation, impulse control, effortful control, and other elements of self-control.

While a number of studies have focused on the relationship between self-regulation and risky sexual behaviors, other studies have implicated impulse control deficits (i.e., behavioral disinhibition; Berdychevsky & Gibson, 2015; Birthrong & Latzman, 2014; Dvorak et al., 2013; Hayaki, Anderson, & Stein, 2006; Sujan, Humphreys, Ray, & Lee, 2014). Over two decades ago, Feldman and Brown (1993) found that boys' self-restraint during childhood was inversely associated with the number of sexual partners years later. Furthermore, in a cross-sectional study of adolescent girls seeking clinic services for either contraceptive advice or termination of a pregnancy, deficits in impulse control significantly predicted membership in the pregnancy group (Rawlings, Boldero, & Wiseman, 1995). More recently, Epstein et al. (2013) demonstrated that adolescent behavioral disinhibition had significant effects on sexual risk taking, which extended into the participants' adulthood. Epstein and

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colleagues (2014) reported that behavioral disinhibition predicts sexual risk behavior over

and above previously identified risk factors.

Purpose of the Study

Given the potentially destructive and life-threatening outcomes of substance use and sexual risk behavior, it is critical that the pathways to such behaviors are identified among college students. To date, however, no study has thoroughly examined the complex relationship between ADHD symptomatology, externalizing symptomatology, EF dysfunction, substance use, and sexual risk behavior, in a sample of college students with and without ADHD. Therefore, the primary purpose of the present study was to propose and test three latent variable models designed to identify the pathways to substance use and sexual risk behavior among college students.

Research Hypotheses

Based on previous empirical findings concerning substance use and sexual risk behavior, it was hypothesized that:

1) ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would be significantly correlated. A more detailed description of the variables of interest can be found in Appendix A.

2) A mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would demonstrate statistically significant pathways between the independent variables, mediators, and dependent variables.

3) A mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would best represent the relationship between the variables, over and above two other nested, latent variable models (i.e., a full model and a direct effects model). More specifically, goodness of fit indices were hypothesized to be strongest for the mediational model relative to the full and direct effects models.

Method

Study Procedure

  The present study employed data collected during the initial year of a five-year longitudinal study (Trajectories Related to ADHD in College [TRAC]) designed to examine the academic and psychosocial outcomes of college students with and without ADHD. In addition to approving the TRAC study, the Institutional Review Board approved the present study. Data were collected across three main universities in the northeast and south regions of the United States. Students enrolled in the study had read and understood the consent form before beginning the instruments The consent form provided a basic description of the research project as well as any potential for harm, confidentiality, and benefits of participating. Participants were made aware that they could discontinue their involvement in the study at any time. Participants were also provided with the principal investigator's contact information if they had any questions or concerns. Graduate assistants, trained as clinical or school psychologists, conducted the assessments during each participant's first year of enrollment in college. During the first assessment, participants provided demographic information, completed the childhood and past 6-month versions of the Attention Deficit Hyperactivity Disorder- Rating Scale (ADHD-RS), the Conners' Adult ADHD Rating Scale- Self-Report: Long Version (CAARS) and the Semi-Structured Interview of Adult ADHD. A panel of experts reviewed results from the first assessment to determine participant eligibility and group membership (i.e., ADHD or comparison). Participants who were determined eligible, completed additional assessments, including computerized testing, additional psychological (e.g., depression and anxiety) rating scales, and a structured clinical interview. For the third stage of the study, participants met with a different graduate

assistant who was blind to the student's group status, during which participants completed intelligence and educational achievement testing and also, provided information concerning their social (e.g., sexual risk behavior) and vocational (e.g., work experience) functioning. Additionally, students provided information regarding their use of support services (e.g., campus support services, medication use, psychotherapy, counseling, etc.).

Participants

Participants (N =411) were recruited through flyers posted on each of the three campuses, emails, classroom visits, and snowball sampling methods. To be eligible for participation, participants had to be 18-25 years of age and enrolled as college freshmen. Further, participants in the ADHD group had to clearly meet DSM-IV criteria for ADHD to be eligible for participation. Participants in the non-ADHD comparison group had to clearly meet criteria for *not* having ADHD. All participants underwent an eligibility screening for ADHD and those not meeting criteria for either of the two groups were excluded from the study.

In terms of demographics, 53.3% of participants were female and 46.7% were male; the mean age of participants was 18.23 years (SD = 0.499) within an age range of 18-22; 10.7% of participants were of Hispanic/Latino ethnicity and 89.3% of non-Hispanic/Latino ethnicity. With regard to race, 72.0% of participants endorsed Caucasian, 11.7% African American, 5.8% Asian, 3.4% bi- or multiracial, and 7.1% endorsed other. Information concerning participant demographics can be found in Table 1.

Measures

Demographic Questionnaire. Students completed a demographic form to indicate their gender, age, race, and ethnicity. Additionally, students were asked to self-report their family composition (i.e., number of siblings, parent's marital status, parental educational level, and parental occupation).

Conners' Adult ADHD Rating Scale - Self-Report: Long Version (CAARS). To assess current ADHD symptomatology, the Conners' Adult ADHD Rating Scale (CAARS) was administered. The CAARS is a 66-item standardized symptom rating scale utilized to assess ADHD in adults (Conners, Erhardt, & Sparrow, 1999). Items are rated on a 4-point Likert scale ranging from 0 (i.e., not at all/never) to 3 (i.e., very much/very frequently). This instrument consists of the following eight subscales with respective reliability coefficients for males and females: 1) inattention/memory problems (0.89, 0.89), 2) hyperactivity/restlessness (0.88, 0.89), 3) impulsivity/emotional ability (0.86, 0.87), 4) problems with self-concept (0.88, 0.87), 5) *DSM-IV* inattentive symptoms (0.81, 0.84), 6) *DSM-IV* hyperactive-impulsive symptoms (0.64, 0.75), 7) *DSM-IV* ADHD symptoms total (0.78, 0.86), and 8) ADHD index (0.82, 0.81). In addition, the CAARS has been reported to have sufficient factorial, discriminant, and construct validity (Conners et al., 1999). Results have demonstrated the scale's ability to identify ADHD symptomatology (Conners et al., 1999). The *DSM-IV* inattentive (IA) symptoms (e.g., "I don't plan ahead", "I have trouble listening to what other people are saying") subscale T-score and the *DSM-IV* hyperactive-impulsive (HI) symptoms ("I am always on the go, as if driven by a motor", "I am a risk-taker or daredevil") subscale T-score served as two continuous independent variables in the present study.

Behavior Rating Inventory of Executive Function-Adult Version (BRIEF-A). The BRIEF-A was developed by Gioia, Isquith, Guy, and Kentworth to assess executive functioning in adults, aged 18 years and older. A higher score indicates greater executive dysfunction (Gioia, Isquith, Guy, & Kentworth, 2000). The BRIEF-A is composed of 75 items with nine overlapping theoretically and empirically derived clinical scales measuring different constructs of executive functioning, including, Inhibit, Shift, Emotional Control, Self-Monitor, Initiate, Working Memory, Plan/Organize, Task Monitor, and Organization of Materials. The clinical scales form two broader scales, the Behavioral Regulation Index (BRI) and the Metacognition Index (MI), as well as an overall summary score, the Global Executive Composite (GEC). The psychometric characteristics of the BRIEF-A are adequate, with an overall Cronbach's alpha of approximately 0.80-0.98, and test-retest reliability between $r = 0.72$-0.92 (Gioia, Isquith, Guy, & Kentworth, 2000) In the present study the Behavioral Regulation Index (BRI) and the Metacognitive Composite (MI) subscales served as continuous mediator variables.

Externalizing Behavior Rating Scale (EBRS). The EBRS was developed to assess self-reported symptoms of Oppositional-Defiant Disorder (ODD) and Conduct Disorder (CD). Modeled after the ADHD-RS, the EBRS first lists the 8 ODD symptoms, followed by the 12 (out of 15) CD items deemed developmentally appropriate for a college population. Similar to the ADHD-RS, each EBRS item is rated on a 0 (not at all) to 3 (very much) scale reflecting the degree to which items characterize a participant's behavior over the past six months. Each EBRS item is summed to yield separate ODD and CD symptom severity total scores, which were entered separately as continuous mediator variables.

Sexual Risk Survey (SRS). The SRS is a 23-item questionnaire, where respondents are asked to report the frequency with which they participated in each of a range of sexual risk behaviors during the preceding 6 months. Frequencies of 0 are coded as "0", and the remaining frequencies are coded into four ordinal categories (i.e., 1 to 4) consistent with the recoding procedure developed by Turchik, Walsh, and Marcus (2015) employed to address positively skewed sexual risk frequency data. For example, item 1 "number of sexual behavioral partners" would be coded as follows, "0= 0", "1= 1", "2-3= 2", "4= 3", and frequencies "5+= 4" (Turchik et al., 2015). Total scores range from 0 to 92 and thus, a higher score indicates greater rates of sexual risk taking (Turchik et al., 2015).

The scale has adequate internal consistency (.90), and the Cronbach's alphas for four of the five subscales, 1) Sexual Risk Taking with Uncommitted Partners, 2) Risky Sex Acts, 3) Impulsive Sexual Behaviors, and 4) Intent to Engage in Risky Sexual Behaviors, have been found to be adequate as well (0.90, 0.82, 0.79, and 0.81, respectively). The internal consistency of the fifth subscale, Risky Anal Sex Acts, however, was poorer at 0.63. Despite the suboptimal internal consistency of the Risky Anal Sex Acts subscale, all five subscales of the SRS were examined, given the importance of addressing risky anal sex behavior when evaluating sexual risk. Moreover, Turchik and Garske (2008) reported that the overall internal consistency coefficient of the SRS did not change regardless of whether items pertaining to the Risky Anal Sex Acts subscale were included or not. Therefore, in the present study, the five subscales were entered separately as dependent variables.

Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST). The ASSIST (W. H. O. Group, 2002) is a structured interview designed to gather information regarding

lifetime and current use of various types of drugs and alcohol. The interview contains

eight questions, and the interviewee provides 10 separate answers for each question about

their use of 10 different substances. There are established skip rules for substances never

used or not currently being used by the interviewee. According to the ASSIST manual,

the scale has high reliability. Of the substances included in the current study, Cronbach's

alpha coefficients range from 0.85 for cannabis and opioids to 0.92 for alcohol. The scale

has adequate concurrent, construct, and discriminative (i.e. the ability to discriminate

between low-, moderate-, and high-risk substance users) validity (Humeniuk et al., 2008).

In the present study, all substances on the scale were assigned to one of three

classifications (i.e., stimulants, depressants, or other) as reported by the Australian

Government Department of Health (2004). The three categories were entered separately

as dependent variables.

Results

Data Analysis

Five different sets of analyses were conducted to test the hypotheses that 1) ADHD

symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual

risk behavior would be significantly correlated, 2) A mediational latent variable model of

ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and

sexual risk behavior would demonstrate statistically significant pathways between the

independent variables, mediators, and dependent variables, and 3) A mediational latent

variable model of ADHD symptomatology, externalizing symptomatology, EF deficits,

substance use, and sexual risk behavior would best represent the relationship between the

variables, over and above two other nested, latent variable models (i.e., a full model and a

direct effects model). More specifically, goodness of fit indices were hypothesized to be strongest for the mediational model relative to the full and direct effects models. The first two analyses related to the exploration of the indicator variables in the present study, while the third analysis was conducted to examine the psychometric properties of the measurement model. The remaining two analyses related to the latent variable models and their goodness of fit. More specifically, analyses included: a) a descriptive examination of all indicator variables, b) Pearson correlation analyses among indicator variables, c) confirmatory factor analyses to examine the psychometric adequacy of the hypothesized measurement model, and d) latent variable modeling was conducted to examine whether a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would best represent the relationship between the variables, over and above two other nested, latent variable models (i.e., a full model and a direct effects model), further, e) the latent variable models were examined in order to determine goodness of fit, while considering while considering both theory and parsimony (Bentler & Mooijaart, 1989). More specifically, maximum likelihood estimation was used to generate chi-squared (χ2) values as a measure of goodness of fit, which was expected to be low relative to the degrees of freedom. Additionally, the root mean square error of approximation (RMSEA; Steiger & Lind, 1980) was expected to be at or below 0.05 (Steiger, 1998), the Bentler Comparative Fit Index (CFI; Bentler, 1990) was expected to be at or above 0.90, and standardized residuals below |.20|.

Missing Data

Given that participants completed the study assessments across three separate sessions, and that not all participants completed all three sessions, sample sizes differ across measures/analyses. As for missing data patterns, the percentage of missing data was generally lower for items administered earlier in the survey (e.g., the CAARS) compared to items administered later in the survey (e.g., EBRS, BRIEF, SRS, ASSIST). The CAARS was completed during the first assessment session, the EBRS was completed during the second assessment, and the BRIEF, SRS, and ASSIST were completed during the third assessment. Thus, due to attrition, the correlation analyses included a sample range of N= 390-411, while the CFA and LVM analyses had an N= 390.

Pearson Correlation Analyses

Prior to conducting confirmatory factor and latent variable modeling analyses, preliminary bivariate correlational analyses were performed. Results, delineated in Table 3, revealed DSM-*IV* inattentive symptoms were significantly and positively correlated with the DSM-*IV* hyperactive-impulsive symptoms ($r = 0.761$, $p < 0.001$), ODD symptom severity ($r = 0.585$, $p < 0.001$), CD symptom severity ($r = 0.273$, $p < 0.001$), behavioral regulation ($r = 0.665$, $p < 0.001$), metacognition ($r = 0.775$, $p < 0.001$), sexual risk taking with uncommitted partners ($r = 0.149$, $p < 0.003$), risky sex acts ($r = 0.193$, $p < 0.001$), intent to engage in risky sexual behaviors ($r = 0.099$, $p < 0.044$), stimulant use ($r = 0.105$, $p < 0.035$), depressant use ($r = 0.116$, $p < 0.020$), and other drug use ($r = 0.164$, $p < 0.001$). DSM-IV inattentive symptoms were not significantly correlated with

impulsive sexual behaviors ($r = 0.080$ $p < 0.105$) and risky anal sex acts ($r = 0.091$, $p < 0.066$).

Results also revealed DSM-*IV* hyperactive-impulsive symptoms were significantly and positively correlated with ODD symptom severity ($r = 0.635$, $p < 0.001$), CD symptom severity ($r = 0.277$, $p < 0.001$), behavioral regulation ($r = 0.725$, $p < 0.001$), metacognition ($r = 0.668$, $p < 0.001$), sexual risk taking with an uncommitted partners ($r = 0.189$, $p < 0.003$), risky sex acts ($r = 0.169$, $p < 0.001$), impulsive sexual behaviors ($r = 0.105$, $p < 0.034$), depressant use ($r = 0.142$, $p < 0.004$), and other drug use ($r = 0.132$, $p < 0.008$). However, intent to engage in risky sexual behaviors ($r = 0.087$, $p < 0.078$), risky anal sex acts ($r = 0.092$, $p < 0.062$), and stimulant use ($r = 0.048$, $p < 0.340$), were not significantly correlated with DSM-*IV* hyperactive-impulsive symptoms.

Significant, positive correlations were also discovered among ODD symptom severity and CD symptom severity ($r = 0.445$, $p < 0.001$), behavior regulation ($r = 0.724$, $p < 0.001$), metacognition ($r = 0.577$, $p < 0.001$), sexual risk taking with uncommitted partners ($r = 0.216$, $p < 0.001$), risky sex acts ($r = 0.153$, $p < 0.002$), impulsive sexual behaviors ($r = 0.112$, $p < 0.026$), depressant use ($r = 0.109$, $p < 0.032$), and other drug use ($r = 0.133$, $p < 0.009$). In contrast, intent to engage in risky sexual behaviors ($r = 0.084$, $p < 0.096$), risky anal sex acts ($r = 0.044$, $p < 0.382$), and stimulant use ($r = 0.075$, $p < 0.142$) were not significantly correlated with ODD symptom severity.

Conduct disorder symptom severity was significantly and positively correlated with behavior regulation ($r = 0.336$, $p < 0.001$), metacognition ($r = 0.330$, $p < 0.001$), sexual risk taking with uncommitted partners ($r = 0.276$, $p < 0.001$), risky sex acts ($r = 0.191$, $p < 0.001$), impulsive sexual behaviors ($r = 0.275$, $p < 0.001$), intent to engage in

risky sexual behaviors ($r = 0.272$, $p < 0.001$), stimulant use ($r = 0.162$, $p < 0.001$), depressant use ($r = 0.227$, $p < 0.001$), and other drug use ($r = 0.265$, $p < 0.001$). Risky anal sex acts, however, was the only variable not significantly correlated with CD symptomatology ($r = 0.039$, $p < 0.440$).

Pearson correlation analyses also revealed significant positive correlations between the behavioral regulation index, a measure of executive function, and metacognition ($r = 0.781$, $p < 0.001$), sexual risk taking with uncommitted partners ($r = 0.203$, $p < 0.001$), risky sex acts ($r = 0.229$, $p < 0.001$), impulsive sexual behaviors ($r = 0.107$, $p < 0.031$), stimulant use ($r = 0.103$, $p < 0.038$), depressant use ($r = 0.148$, $p < 0.003$), and other drug use ($r = 0.205$, $p < 0.001$). Variables not significantly associated with the behavioral regulation index include intent to engage in risky sexual behaviors ($r = 0.052$, $p < 0.297$) and risky anal sex acts ($r = 0.079$, $p < 0.112$).

The metacognition index, another measure of executive function, demonstrated significant positive correlations with sexual risk taking with uncommitted partners ($r = 0.192$, $p < 0.001$), risky sex acts ($r = 0.199$, $p < 0.001$), impulsive sexual behaviors ($r = 0.103$, $p < 0.038$), risky anal sex acts ($r = 0.112$, $p < 0.024$), depressant use ($r = 0.153$, $p < 0.002$), and other drug use ($r = 0.186$, $p < 0.001$). Variables not significantly correlated include intent to engage in risky sexual behaviors ($r = 0.076$, $p < 0.127$) and stimulant use ($r = 0.087$, $p < 0.079$).

Structural Equation Modeling

Confirmatory factor analyses were performed on the measurement model, testing the sufficiency of the model and associations among the latent variables (Bentler, 2004). Results of the correlated five-factor model demonstrated relatively poor fit: χ^2 (67, N=

390) = 348.049, $p < 0.001$, RMSEA = 0.104, CFI = 0.894, 90%CI [0.093, 0.115]. The latent variable, ADHD symptomatology, comprised the DSM-IV inattentive indicator (.865) and the DSM-*IV* hyperactive-impulsive indicator (.876). The latent mediator variable, externalizing symptomatology, sustained both the ODD (.929) and CD (.472) indicators, while the behavioral regulation index (.906) and the metacognition index (.858), served as indicators of the latent mediator variable, executive function. In addition, four of the five hypothesized indicators of the latent variable sexual risk behavior, including sexual risk behavior with uncommitted partners (.827), risky sex acts (.544), impulsive sexual behaviors (.819), intent to engage in risky sexual behaviors (.716) demonstrated statistically significant loadings. Risky anal sex acts, the fifth indicator of sexual risk behavior, did not demonstrate a significant loading (.252). Lastly, three proposed indicators of substance use (i.e., stimulant use, depressant use, other drug use) demonstrated satisfactory factor loadings (.444, .715, .743, respectively).

Risky anal sex acts, an indicator of sexual risk behavior, was dropped based on its poor factor loading. Subsequently, a confirmatory factor analysis was performed without the poor fitting indicator. The model, depicted in Figure 1, demonstrated statistically significant loadings among all the indicators and their respective latent variables. Further, the latent variables in the model demonstrated statistically significant correlations, as seen in Table 4. The correlated five-factor model yielded improved results: χ^2 (55, N= 390) = 314.430, $p < 0.001$, RMSEA = 0.110, CFI = 0.901, 90%CI [0.098, 0.122]. Moreover, the correlated model yielded standardized residuals falling below the |.20| criteria, furthering strengthening the conclusion that the best-fit model is the correlated five-factor model without the risky anal sex indicator.

Three latent variable models included a latent, independent variable, ADHD symptomatology, as measured by the DSM-IV inattentive symptom scale and the DSM-*IV* hyperactive-impulsive symptom scale. Two correlated variables, the behavioral regulation index and the metacognition index, served as measures of the latent mediator variable, executive function. The latent mediator variable, externalizing symptomatology comprised two correlated variables, the CD symptom scale score and the ODD symptom scale score. Lastly, the latent dependent variable, sexual risk, was measured by four correlated, subscale scores on the SRS (i.e., sexual risk behavior with uncommitted partners, risky sex acts, impulsive sexual behaviors, intent to engage in risky sexual behaviors) and the latent dependent variable, substance use, was measured by three classifications of substances (i.e., stimulants, depressants, and other).

ADHD symptomatology was expected to significantly predict both executive dysfunction and externalizing symptomatology. In turn, executive dysfunction and externalizing symptomatology were expected to significantly predict sexual risk and substance use. The association between ADHD symptomatology, sexual risk, and substance use was expected to become nonsignificant when accounting for the effects of executive dysfunction and externalizing symptomatology, suggesting full mediation (Baron & Kenny, 1986). The second alternative full model suggested that additional paths between the latent variables of ADHD symptomatology (independent variable), sexual risk (dependent variable), and substance use (dependent variable) best represented the data, suggesting partial mediation. In contrast, the third alternative direct model posited that there was a direct path between ADHD symptomatology, externalizing

symptomatology, executive dysfunction, sexual risk, and substance use, with no mediating effects.

As stated previously, the mediation model was expected to best represent the data, considering model fit indices, theory, and parsimony. Results of the mediation and full models, however, resulted in specification errors that could not be resolved into meaningful solutions. While, results of the direct model depicted overall model fit as relatively poor: χ^2 (59, N= 390) = 321.416, p < 0.00100, RMSEA = 0.107, CFI = 0.900, 90%CI [0.095, 0.118]. As depicted in Figure 2, ADHD symptomatology predicted the two latent mediator variables, executive dysfunction (β = .182) and externalizing symptomatology (β = .641), in addition to the two outcome variables, sexual risk behavior (β = .063) and substance use (β = .004). Results also demonstrated significant covariance between externalizing symptomatology and executive dysfunction, and substance use and sexual risk behavior, respectively (5.61, .832). It is plausible then, that specification errors of the mediation and full models may in part, be due to high collinearity between the mediator and outcome variables of interest.

Although results were supportive of the direct model, potential problems in the interpretation of these findings should be taken into consideration. First, it is important to note that fit indices of the direct model were relatively poor. For example, the root mean square error of approximation was above the suggested 0.05 level (Steiger & Lind, 1980) while the Bentler Comparative Fit Index (CFI; Bentler, 1990), reached the 0.90 level. Additionally, 4 out of the 20 largest standardized residuals exceeded the criterion of |.20|., ranging from .204 to .225. This may have contributed to the overall poor model fit.

Finally, the chi-squared statistic for the direct model was quite large (i.e., χ^2 (59, N= 390) = 321.416, p < 0.00100).

Discussion

Although research has identified ADHD symptomatology, externalizing symptomatology, and EF deficits as predictors of substance use and sexual risk behavior and their damaging effects, the present study was the first to systematically examine potential pathways between these variables. Specifically, it was hypothesized that: 1) ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would be significantly correlated (see Appendix A for a more detailed description of the variables of interest); 2) a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would demonstrate statistically significant paths between the independent variables, mediators, and dependent variables; 3) a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would best represent the relationship between the variables, over and above two other nested, latent variable models (i.e., a full model and a direct effects model). Specifically, goodness of fit indices were hypothesized to be strongest for the mediational model relative to the full and direct effects models.

Pearson Correlation Findings

Preliminary correlational analyses were partially supportive of hypothesis 1) that ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would be significantly correlated. More specifically, results revealed that ADHD-IA symptomatology was significantly and positively correlated with ADHD-

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HI symptomatology, ODD symptomatology, CD symptomatology, behavioral regulation

difficulties, metacognitive dysfunction, sexual risk taking with uncommitted partners,

risky sex acts, intent to engage in risky sexual behavior, stimulant use, depressant use,

and other drug use. Alternatively, impulsive sexual behaviors and risky anal sex acts

were not significantly associated with ADHD-IA symptomatology. While research has

linked ADHD symptomatology and sexual risk behavior (Barkley et al., 2006; Flory et

al., 2006) Sarver, McCart, Sheidow, and Letourneau (2014) reported that ADHD-HI, but

not ADHD-IA symptoms were associated with risky sexual behavior. Therefore, it is

plausible that ADHD-IA and ADHD-HI predict different types of behavior, including

sexual risk behavior, thereby providing a potential explanation for why ADHD-IA was

not associated with impulsive sexual behaviors and risky anal sex acts.

Similarly, ADHD-HI symptomatology was significantly and positively correlated

with ODD symptomatology, CD symptomatology, behavioral regulation difficulties,

metacognition dysfunction, sexual risk-taking with uncommitted partners, risky sex acts,

depressant use, and other drug use. However, unlike ADHD-IA, ADHD-HI

symptomatology was also positively associated with impulsive sexual behaviors, which is

consistent with previous research (Sarver et al., 2014). Findings also suggested that

ADHD-HI symptomatology was not significantly associated with the intent to engage in

risky sexual behavior, which conceptually makes sense, as college students with

hyperactive-impulsive symptomatology may not consider their risk behavior prior to the

time in which it occurs. Furthermore, ADHD-HI was not significantly correlated with

risky anal sex acts and stimulant use, as was predicted. One plausible explanation as to

why ADHD-HI was not associated with stimulant use, but with depressant and other drug

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use, is because the substances assigned to the stimulant classification (e.g., cocaine),

typically provide increased motor activity, which is already characteristic of students with

ADHD-HI symptomatology (Tseng, Henderson, Chow, & Yao, 2004). Despite this

plausible explanation, a recent meta-analytic review linked childhood ADHD with

stimulant (i.e., cocaine) abuse or dependence in adolescence and young adulthood (Lee et

al., 2011). Provided these mixed results, future research must examine the unique

relationship between ADHD-HI symptomatology and substance abuse among various

stimulants (e.g., cocaine, speed, ecstasy).

Significant positive correlations were also discovered among ODD

symptomatology and CD symptomatology, behavioral regulation difficulties,

metacognitive dysfunction, sexual risk taking with uncommitted partners, risky sex acts,

impulsive sexual behaviors, depressant use, and other drug use. In contrast, intent to

engage in risky sexual behaviors, risky anal sex acts, and stimulant use were not

significantly correlated with ODD symptomatology. Similarly, CD symptomatology was

significantly and positively correlated with behavioral regulation difficulties,

metacognition dysfunction, sexual risk taking with uncommitted partners, risky sex acts,

impulsive sexual behaviors, depressant use, and other drug use. In contrast to ODD

symptomatology, however, CD symptomatology was associated with the intent to engage

in risky sexual behaviors and stimulant use. Risky anal sex acts, however, was the only

variable not significantly correlated with CD symptomatology. One plausible explanation

for why risky anal sex acts were not associated with ADHD-IA symptomatology,

ADHD-HI symptomatology, ODD symptomatology, or CD symptomatology relates to

the small number of participants reporting at least one anal sex behavior (n=53) and the low internal consistency of the subscale.

Preliminary correlational analyses also revealed positive correlations among behavioral regulation difficulties and metacognitive dysfunction, sexual risk taking with uncommitted partners, risky sex acts, impulsive sexual behaviors, stimulant use, depressant use, and other drug use. Variables not significantly associated with the behavioral regulation index include the intent to engage in risky sexual behaviors and risky anal sex acts. Similarly, metacognitive dysfunction, demonstrated significant positive correlations with sexual risk taking with uncommitted partners, risky sex acts, impulsive sexual behaviors, depressant use, and other drug use. Metacognitive dysfunction was not associated with the intent to engage in risky sexual behavior or stimulant use. Interestingly, metacognitive dysfunction *was* associated with risky anal sex acts, one of the riskiest sexual behaviors, highlighting the important role of self-awareness, the ability to self-monitor, and problem solve, in order to prevent risk behavior. Therefore, future risk prevention intervention programs with college students should include activities to help build executive function skills, including metacognition. Indeed, previous HIV prevention intervention research documented that an intervention increasing self-monitoring resulted in increased protected sex with sexual partners, and changes in attitudes conducive to reducing risk (Lightfoot, Rotheram-Borus, Comulada, Gundersen, & Reddy, 2007). More recently, researchers have begun to identify preferences for mobile health applications used to increase self-monitoring and self-management, providing support for future mobile risk prevention interventions (Ramanathan, Swendeman, Comulada, Estrin, & Rotheram-Borus, 2013). Based on these

findings, mobile self-monitoring interventions at the college level may be a feasible and efficacious way to prevent sexual risk behavior and its detrimental outcomes.

Structural Equation Modeling Findings

Confirmatory factor analyses were employed to validate the psychometric adequacy of the measurement model. One indicator of sexual risk behavior, risky anal sex acts, was dropped based on it poor factor loading. As described previously, the risky anal sex acts scale has relatively poor internal consistency and in the present study, low reporting, which may in part explain the problems associated with this factor. Once this indicator was dropped, a subsequent confirmatory factor analysis demonstrated statistically significant loadings among all indicators and their respective latent variables, ranging from 0.438 to 0.928. Furthermore, the latent variables demonstrated strong intercorrelations, ranging from 0.186 to 0.913.

Next, latent variable modeling analyses were employed. Results were not supportive of hypothesis 2) that a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would demonstrate statistically significant paths between the independent variables, mediators, and dependent variables. However, as depicted in Figure 2 (i.e., the direct model), the ADHD symptomatology latent variable predicted the two proposed latent mediator variables, externalizing symptomatology and executive dysfunction. These findings are well supported by previous research, with several studies documenting a strong link between ADHD symptomatology and executive function problems (Brown & Casey, 2016; Toplak, Bucciarelli, Jain, & Tannock, 2008; Wahlstedt, Thorell, & Bohlin, 2008; Weyandt 2009; Weyandt et al., 2014; Wilcutt, Doyle, Nigg, Faraone,

Pennington, 2005), and externalizing symptomatology, respectively (Murphy & Barkley, 1996; Murphy, Barkley, & Bush, 2002). Interestingly, previous research suggests a stronger relationship between ADHD-HI and externalizing problems, compared to ADHD-IA (Murphy et al., 2002). In fact, a more recent study examined the relationship between ADHD-IA, ADHD-HI, executive function, and ODD symptomatology, and found that executive function was the strongest predictor of ADHD-IA, while ODD symptomatology was the strongest predictor of ADHD-HI (Brown & Casey, 2016). Results of the present study and previous research suggest that college students with ADHD symptomatology may have substantial problems managing not only their ADHD symptoms, but also their executive functioning and externalizing behaviors associated with these symptoms.

In addition to the significant pathways between the latent independent variable, ADHD symptomatology, and the two proposed latent mediator variables, executive dysfunction and externalizing symptomatology, the direct model demonstrated significant pathways between ADHD symptomatology, substance use, and sexual risk behavior, respectively. While specification errors did not allow for examination of potential mediators, it is plausible, that ADHD symptomatology underlying and/or comorbid with externalizing problems is most predictive of substance use behavior. In fact, previous research suggests that ADHD symptomatology is an independent risk factor for substance use problems (Frodl, 2010; van Emmerik-van Oortmerssen, 2012; Wilens & Spencer, 2010), however, a combination of ADHD and externalizing problems places individuals at greatest risk for substance use disorders (Flory & Lynham, 2003). Thus, ADHD and externalizing symptomatology appear to play an important role in predicting substance

use behavior, however, the way in which the two variables interact requires further investigation.

Latent variable modeling analyses were not supportive of hypothesis 3) that a mediational latent variable model of ADHD symptomatology, externalizing symptomatology, EF deficits, substance use, and sexual risk behavior would best represent the relationship between the variables, over and above two other nested, latent variable models (i.e., a full model and a direct effects model). Results demonstrated the direct model as best fit, with the mediation and full models producing specification errors. While the direct model was preferred, these results must be considered cautiously. As mentioned previously, the overall model fit was relatively poor, for example, the chi-squared statistic was quite large, the root mean square error of approximation was above the suggested 0.05 level (Steiger & Lind, 1980), while the Bentler Comparative Fit Index (CFI; Bentler, 1990), reached the 0.90 level. Additionally, 4 out of the 20 largest standardized residuals exceeded the criterion of $|.20|$, which may have contributed to the overall poor model fit.

Collectively, findings from the present study suggest that ADHD symptomatology, externalizing symptomatology, EF dysfunction, substance use, and sexual risk behavior, are significantly correlated constructs, with complex, interconnected, pathways. Pathways that appear to have the strongest relationships include those between ADHD symptomatology, externalizing symptomatology, and EF dysfunction. These findings highlight the importance of providing students with ADHD symptomatology, externalizing symptomatology, and EF deficits effective prevention intervention programs in the college environment (Weyandt, Oster, Gudmundsdottir,

DuPaul, & Anastopoulos, 2017). Research regarding psychosocial treatment of ADHD symptomatology in college students is limited and preliminary; however, findings reported by Parker, Hoffman, Sawilowsky, and Rolands (2011) suggest ADHD coaching helped students develop more productive beliefs, experience more positive feelings, and engage in more self-regulated behaviors. Furthermore, Anastopoulos and King (2015), who employed a cognitive behavioral therapy and individual mentoring model, reported promising results with increases in ADHD knowledge, organizational skills, and decreased maladaptive thinking. The study also reported reductions in ADHD symptoms, improvements in executive functioning, educational benefits, improved emotional health, and increased use of campus resources. Fleming, McMahon, Moran, Peterson, and Dreessen (2015) conducted a randomized controlled pilot trial offering group sessions of dialectical behavior therapy (DBT) to college students with ADHD symptomatology and EF deficits. DBT training was associated with greater improvement in ADHD symptomatology, EF, and quality of life than the control condition. College campuses should also consider offering universal substance use and sexual risk prevention programs highlighting effective coping strategies, given the success of these programs among adolescent populations (Griffin & Botvin, 2010).

Limitations and Future Directions

Although this study is the first to rigorously examine the complex relationship between ADHD symptomatology, externalizing symptomatology, EF dysfunction, substance use, and sexual risk behavior, in a sample of college students with and without ADHD, several limitations of the present study should be considered. First, the study was cross-sectional, which disregards the role of time and development in mediation models.

Further, the sample was one of convenience; therefore, participants may differ from the larger population of college students on a number of variables, including ADHD symptomatology, externalizing symptomatology, executive function, substance use, and sexual risk behavior, which may limit the generalizability of the findings. Although the sample was geographically diverse, it was also relatively homogenous with regard to race and ethnicity, which also restricts the generalizability of the findings. Additionally, the present study used data from first-year students only and may underestimate the true prevalence of risk behavior among college students. Future studies should examine college students later in their academic careers. Furthermore, the present study examined college students at 4-year universities, and results may differ with students at 2-year colleges.

Future studies exploring the relationship between ADHD symptomatology, externalizing symptomatology, executive function, substance use, and sexual risk behavior are encouraged to employ a more representative sample of college students. Ideally, studies would be longitudinal, and include greater focus on the interaction between variables. For example, previous research in conjunction with the present study highlights the important and complex interaction between ADHD, externalizing symptomatology, and its relationship with substance use. This interaction should be studied, provided the detrimental outcomes of substance abuse in college. Furthermore, the pathway between ADHD symptomatology and executive dysfunction should be studied with greater detail, given the increasing numbers of students with ADHD entering college. Such research would inform future prevention intervention programs greatly.

Conclusion

The current study was the first to systematically examine the complex relationship between ADHD symptomatology, externalizing symptomatology, EF dysfunction, substance use, and sexual risk behavior in a sample of college students with and without ADHD symptomatology. The primary purpose of the present study was to propose and test a latent variable model, identifying the pathways to substance use and sexual risk behavior among college students with ADHD symptomatology. Results revealed significant correlations among the variables of interest and three nested, latent variable models were analyzed (mediational model, full model, and a direct effects model). Contrary to hypotheses, the direct model demonstrated best fit, while the mediational and full latent variables models demonstrated specification errors that could not be resolved into meaningful solutions. More specifically, the latent variable, ADHD symptomatology, was predictive of the two proposed latent mediator variables, externalizing symptomatology and executive dysfunction. Furthermore, substance use and sexual risk behavior were predicted by ADHD symptomatology.

Preliminary evidence from the present study supports the existence of a strong, multifaceted relationship between ADHD symptomatology, externalizing symptomatology, executive dysfunction, substance use, and sexual risk behavior, respectively. Latent variable modeling analyses suggest that ADHD symptomatology predicts externalizing symptomatology, executive dysfunction, sexual risk, and substance use, with no mediating effects. Results of the study highlight the importance of providing college students with ADHD symptomatology effective psychosocial and behavioral prevention and intervention programs within the campus environment. More specifically,

interventions should establish effective coping skills to help students manage ADHD symptoms, executive function deficits, and behavioral problems. In addition, universal substance use and sexual risk programs should include similar coping strategies, given the relationship between ADHD symptomatology and risk behavior.

The present findings have important implications for public health policy, particularly as it relates to the college population. Educating college students about the relationship betweem substance use and sexual risk behavior is clearly warranted. Given that many college students who take part in such risky behaviors also experience ADHD symptomatology, externalizing symptomatology, and EF dysfunction, it is crucial that college students be provided with academic and psychosocial supports to help manage their cognitive processes, feelings, and behaviors. Future universal risk prevention intervention programs should incorporate cognitive behavioral and dialectical behavioral coping strategies that have shown promise among college student populations.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental health disorders: DSM-5 (5th ed.)*. Washington, DC: American Psychiatric Publishing.

Anastopoulos, A. D., & King, K. A. (2015). A cognitive-behavior therapy and mentoring program for college students with ADHD. *Cognitive and Behavioral Practice*, *22*(2), 141-151.

Australian Government Department of Health. (2004). Classifying drugs by their effect on the central nervous system. Retrieved from: http://www.health.gov.au/internet/publications/publishing.nsf/Content/drugtreat-pubs-front6-wk-toc~drugtreat-pubs-front6-wk-secb~drugtreat-pubs-front6-wk-secb-3~drugtreat-pubs-front6-wk-secb-3-1

Aytaclar, S., Tarter, R. E., Kirisci, L., & Lu, S. (1999). Association between hyperactivity and executive cognitive functioning in childhood and substance use in early adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry*, *38*(2), 172-178.

Baker, L., Prevatt, F., & Proctor, B. (2012). Drug and alcohol use in college students with and without ADHD. *Journal of Attention Disorders, 16*(3), 255-263.

Barkley, R. A. (2012). *Executive Functions: What they are, how they work, and why they evolved*. New York: Guilford Press.

Barkley, R. A. (2006). *Attention-deficit hyperactivity disorder: A handbook for diagnosis and treatment* (3rd ed.). New York: Guildford Press.

Barkley, R. A., Murphy, K. R., & Fischer, M. (2008). *ADHD in Adults: What the Science Says*. New York: Guilford.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*(6), 1173.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238-246.

Bentler, P. M. & Mooijaart, A. (1989). Choice of structural model via parsimony: A rationale based on precision. *Psychological Bulletin*, *106*(2), 315-317.

Berdychevsky, L., & Gibson, H. J. (2015). Phenomenology of young women's sexual risk-taking in tourism. *Tourism Management*, *46*, 299-310.

Berger, A. (2011). *Self-regulation: Brain, cognition, and development*. American Psychological Association.

Bidwell, L. C., Henry, E. A., Willcutt, E. G., Kinnear, M. K., & Ito, T. A. (2014). Childhood and current ADHD symptom dimensions are associated with more severe cannabis outcomes in college students. *Drug and Alcohol Dependence*, *135*(1), 88-94.

Biederman, J., Petty, C. R., Evans, M., Small, J., & Faraone, S. V. (2010). How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Research*, *177*(3), 299-304.

Birthrong, A., & Latzman, R. D. (2014). Aspects of impulsivity and differentially associated with risky sexual behaviors. *Personality and Individual Differences, 57,* 8-13.

Brown, A. J., & Casey, B. M. (2016). Subclinical ADHD-symptoms are associated with

    executive-functioning and externalizing problems in college students without

    ADHD-diagnoses. *Journal of Educational and Developmental Psychology*, *6*(1),

    204.

Brown, L. K., Hadley, W., Stewart, A., Lescano, C., Whiteley, L., Donenberg, G., &

    DiClemente, R. (2010). Psychiatric disorders and sexual risk among adolescents

    in mental health treatment. *Journal of Consulting and Clinical Psychology*, *78*(4),

    590.

Bussing, R., Mason, D. M., Bell, L., Porter, P., & Garvan, C. (2010). Adolescent

    outcomes of childhood attention-deficit/hyperactivity disorder in a diverse

    community sample. *Journal of the American Academy of Child & Adolescent*

    Psychiatry, *49*(6), 595-605.

Conners, C. K., Erhardt, D., & Sparrow, E. P. (1999). *Conners' adult ADHD rating*

    scales (CAARS): Technical manual. North Tonawanda, NY: Multi-Health

    Systems.

Crockett, L. J., Raffaelli, M., & Shen, Y. L. (2006). Linking self-regulation and risk

    proneness to risky sexual behavior: Pathways through peer pressure and early

    substance use. *Journal of Research on Adolescence*, *16*(4), 503-525.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests.

    Psychometrika, *16*, 297-334.

Cutuli, J. J., Gillham, J. E., Chaplin, T. M., Reivich, K. J., Seligman, M. E., Gallop, R. J.,

    ... & Freres, D. R. (2013). Preventing adolescents' externalizing and internalizing

symptoms: Effects of the Penn Resiliency Program. *The International Journal of Emotional Education*, *5*(2), 67.

Dalsgaard, S., Ostergaard, S. D., Leckman, J. F., Mortensen, P. B., & Pedersen, M. G. (2015). Mortality in children, adolescents, and adults with attention deficit hyperactivity disorder: a nationwide cohort study. *The Lancet*, *385*(9983), 2190-2196.

Deckel, A. W., & Hesselbrock, V. (1996). Behavioral and cognitive measurements predict scores on the MAST: A 3-year prospective study. *Alcoholism: Clinical and Experimental Research*, *20*(7), 1173-1178.

Dunne, E. M., Hearn, L. E., Rose, J. J., & Latimer, W. W. (2014). ADHD as a risk factor for early onset and heightened adult problem severity of illicit substance use: An accelerated gateway model. *Addictive Behaviors*, *39*(12), 1755-1758.

Dvorak, R. D., & Day, A. M. (2014). Marijuana and self-regulation: Examining likelihood and intensity of use and problems. *Addictive Behaviors*, *39*(3), 709-712.

Eagan, K., Stolzenberg, E. B., Ramirez, J. J., Aragon, M. C., Suchard, M. R., & Hurtado, S. (2014). *The American freshman: National norms fall 2014*. Los Angeles: Higher Education Research Institute, UCLA.

Epstein, M., Bailey, J. A., Manhart, L. E., Hill, K. G., & Hawkins, J. D. (2014). Sexual risk behavior in young adulthood: Broadening the scope beyond early sexual initiation. *The Journal of Sex Research*, *51*(7), 721-730.

Epstein, M., Hill, K. G., Bailey, J. A., & Hawkins, J. D. (2013). The effect of general and

    drug-specific family environments on comorbid and drug-specific problem

    behavior: A longitudinal examination. *Developmental Psychology*, *49*(6), 1151.

Feldman, S. S., & Brown, N. L. (1993). Family influences on adolescent male sexuality:

    the mediational role of self-restraint. *Social Development*, *2*(1), 15-35.

Fischer, M., Barkley, R. A., Smallish, L., & Fletcher, K. (2002). Young adult follow-up

    of hyperactive children: Self-reported psychiatric disorders, comorbidity, and the

    role of childhood conduct problems and teen CD. *Journal of Abnormal Child*

    Psychology, *30*(5), 463-475.

Fleming, A. P., McMahon, R. J., Moran, L. R., Peterson, A. P., & Dreessen, A. (2015).

    Pilot randomized controlled trial of dialectical behavior therapy group skills

    training for ADHD among college students. *Journal of Attention*

    Disorders, *19*(3), 260-271.

Flory, K., & Lynam, D. R. (2003). The relation between attention deficit hyperactivity

    disorder and substance abuse: What role does conduct disorder play?. *Clinical*

    Child and Family Psychology Review, *6*(1), 1-16.

Flory, K., Molina, B. S., Pelham, Jr, W. E., Gnagy, E., & Smith, B. (2006). Childhood

    ADHD predicts risky sexual behavior in young adulthood. *Journal of Clinical*

    Child and Adolescent Psychology, *35*(4), 571-577.

Frodl, T. (2010). Comorbidity of ADHD and substance use disorder (SUD): a

    neuroimaging perspective. *Journal of Attention Disorders*, *14*(2), 109-120.

Fuemmeler, B. F., Kollins, S. H., & McClernon, F. J. (2007). Attention deficit

    hyperactivity disorder symptoms predict nicotine dependence and progression to

regular smoking from adolescence to young adulthood. *Journal of Pediatric Psychology*, *32*(10), 1203-1213.

Garcia, C. R., Bau, C. H. D., Silva, K. L., Callegari-Jacques, S. M., Salgado, C. A. I., Fischer, A. G., ... & Belmonte-de-Abreu, P. (2012). The burdened life of adults with ADHD: impairment beyond comorbidity. *European Psychiatry*, *27*(5), 309-313.

Gioia, G., Isquith, P., Guy, S., & Kentworth, L. (2000). *Behavior Rating Inventory of Executive Function, BRIEF Adult Version*. Florida: PAR.

Glass, K., & Flory, K. (2012). Are symptoms of ADHD related to substance use among college students?. *Psychology of Addictive Behaviors*, *26*(1), 124-132.

Gottfredson, N. C., & Hussong, A. M. (2013). Drinking to dampen affect variability: Findings from a college student sample. *Journal of Studies on Alcohol and Drugs*, *74*(4), 576.

Griffin, K. W., & Botvin, G. J. (2010). Evidence-based interventions for preventing substance use disorders in adolescents. *Child and Adolescent Psychiatric Clinics of North America*, *19*(3), 505-526.

Harty, S. C., Galanopoulos, S., Newcorn, J. H., & Halperin, J. M. (2013). Delinquency, aggression, and attention-related problem behaviors differentially predict adolescent substance use in individuals diagnosed with ADHD. *The American Journal on Addictions*, *22*(6), 543-550.

Hawkins, J. D., Catalano, R. F., & Miller, J. Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin*, *112*(1), 64.

Hayaki, J., Anderson, B., & Stein, M. (2006). Sexual risk behaviors among substance

    users: relationship to impulsivity. *Psychology of Addictive Behaviors*, *20*(3), 328.

Hill, K. G., Hawkins, J. D., Bailey, J. A., Catalano, R. F., Abbott, R. D., & Shapiro, V. B.

    (2010). Person–environment interaction in the prediction of alcohol abuse and

    alcohol dependence in adulthood. *Drug and Alcohol Dependence*, *110*(1), 62-69.

Hittner, J. B., & Swickert, R. (2006). Sensation seeking and alcohol use: A meta-analytic

    review. *Addictive Behaviors*, *31*(8), 1383-1401.

Hosain, G. M., Berenson, A. B., Tennen, H., Bauer, L. O., & Wu, Z. H. (2012). Attention

    deficit hyperactivity symptoms and risky sexual behavior in young adult women.

    Journal of Women's Health, *21*(4), 463-468.

Huggins, S. P., Rooney, M. E., & Chronis-Tuscano, A. (2015). Risky sexual behavior

    among college students with ADHD is the mother–child relationship protective?.

    Journal of Attention Disorders, *19*(3), 240-250.

Humeniuk, R., Ali, R., Babor, T. F., Farrell, M., Formigoni, M. L., Jittiwutikarn, J., ... &

    Simon, S. (2008). Validation of the alcohol, smoking and substance involvement

    screening test (ASSIST). *Addiction*, *103*(6), 1039-1047.

Hussong, A. M., Curran, P. J., & Chassin, L. (1998). Pathways of risk for accelerated

    heavy alcohol use among adolescent children of alcoholic parents. *Journal of*

    Abnormal Child Psychology, *26*(6), 453-466.

Hustad, J. T., Carey, K. B., Carey, M. P., & Maisto, S. A. (2009). Self-regulation, alcohol

    consumption, and consequences in college student heavy drinkers: A

    simultaneous latent growth analysis. *Journal of Studies on Alcohol and*

    Drugs, *70*(3), 373-382.

Iacono, W. G., Malone, S. M., & McGue, M. (2008). Behavioral disinhibition and the

    development of early-onset addiction: common and specific influences. *Annual*

    Review Clinical Psychology, *4*, 325-348.

Kessler, R. C., Adler, L., Barkley, R., Biederman, J., Conners, C. K., Demler, O., ... &

    Spencer, T. (2006). The prevalence and correlates of adult ADHD in the United

    States: Results from the National Comorbidity Survey Replication. *American*

    Journal of Psychiatry.

King, S. M., Iacono, W. G., & McGue, M. (2004). Childhood externalizing and

    internalizing psychopathology in the prediction of early substance use.

    Addiction, *99*(12), 1548-1559.

Langberg, J. M., Dvorsky, M. R., Kipperman, K. L., Molitor, S. J., & Eddy, L. D. (2014).

    Alcohol use longitudinally predicts adjustment and impairment in college students

    with ADHD: The role of executive functions. *Psychology of Addictive Behaviors*.

Langley, K., Fowler, T., Ford, T., Thapar, A. K., van den Bree, M., Harold, G., ... &

    Thapar, A. (2010). Adolescent clinical outcomes for young people with attention-

    deficit hyperactivity disorder. *The British Journal of Psychiatry*, *196*(3), 235-240.

Lee, S. S., Humphreys, K. L., Flory, K., Liu, R., & Glass, K. (2011). Prospective

    association of childhood attention-deficit/hyperactivity disorder (ADHD) and

    substance use and abuse/dependence: a meta-analytic review. *Clinical Psychology*

    Review, *31*(3), 328-341.

Leibson, C. L., Katusic, S. K., Barbaresi, W. J., Ransom, J., & O'Brien, P. C. (2001). Use

    and costs of medical care for children and adolescents with and without attention-

deficit/hyperactivity disorder. *The Journal of the American Medical Association*, *285*(1), 60-66.

Lightfoot, M., Rotheram-Borus, M. J., Comulada, S., Gundersen, G., & Reddy, V. (2007). Self-monitoring of behaviour as a risk reduction strategy for persons living with HIV. *AIDS Care*, *19*(6), 757-763.

Lochman, J. E., Powell, N. P., Boxmeyer, C. L., & Jimenez-Camargo, L. (2011). Cognitive-behavioral therapy for externalizing disorders in children and adolescents. *Child and Adolescent Psychiatric Clinics of North America*, *20*(2), 305-318.

Moilanen, K. L. (2015). Predictors of latent growth in sexual risk taking in late adolescence and early adulthood. *The Journal of Sex Research*, *52*(1), 83-97.

Molina, B. S., Hinshaw, S. P., Swanson, J. M., Arnold, L. E., Vitiello, B., Jensen, P. S., ... & Elliott, G. R. (2009). The MTA at 8 years: Prospective follow-up of children treated for combined-type ADHD in a multisite study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *48*(5), 484-500.

Molina, B. S., & Pelham Jr, W. E. (2014). Attention-deficit/hyperactivity disorder and risk of substance use disorder: Developmental considerations, potential pathways, and opportunities for research. *Annual Review of Clinical Psychology*, *10*, 607.

Molina, B. S., & Pelham Jr, W. E. (2003). Childhood predictors of adolescent substance use in a longitudinal study of children with ADHD. *Journal of Abnormal Psychology*, *112*(3), 497.

Muraven, M., & Baumeister, R. F. (2000). Self-regulation and depletion of limited

    resources: Does self-control resemble a muscle?. *Psychological Bulletin*, *126* (2),

    247.

Murphy, K., & Barkley, R. A. (1996). Attention deficit hyperactivity disorder adults:

    Comorbidities and adaptive impairments. *Comprehensive Psychiatry*, *37*(6), 393-

    401.

Murphy, K. R., Barkley, R. A., & Bush, T. (2002). Young adults with attention deficit

    hyperactivity disorder: Subtype differences in comorbidity, educational, and

    clinical history. *The Journal of Nervous and Mental Disease*, *190*(3), 147-157.

Murphy, K. R., Barkley, R. A., & Bush, T. (2001). Executive functioning and olfactory

    identification in young adults with attention deficit-hyperactivity

    disorder. *Neuropsychology*, *15*(2), 211.

Nigg, J. T. (2013). Attention-deficit/hyperactivity disorder and adverse health

    outcomes. *Clinical Psychology Review*, *33*(2), 215-228.

Nigg, J. T., Wong, M. M., Martel, M. M., Jester, J. M., Puttler, L. I., Glass, J. M., ... &

    Zucker, R. A. (2006). Poor response inhibition as a predictor of problem drinking

    and illicit drug use in adolescents at risk for alcoholism and other substance use

    disorders. *Journal of the American Academy of Child & Adolescent

    Psychiatry*, *45*(4), 468-475.

Noar, S. M. (2003). The role of structural equation modeling in scale development.

    Structural Equation Modeling, *10*(4), 622-647.

Parker, D. R., Hoffman, S. F., Sawilowsky, S., & Rolands, L. (2011). An examination of the effects of ADHD coaching on university students' executive functioning. *Journal of Postsecondary Education and Disability*, *24*(2), 115-132

Quinn, P. D., & Fromme, K. (2010). Self-regulation as a protective factor against risky drinking and sexual behavior. *Psychology of Addictive Behaviors*, *24*(3), 376.

Rabiner, D. L., Anastopoulos, A. D., Costello, J., Hoyle, R. H., & Swartzwelder, H. S. (2008). Adjustment to college in students with ADHD. *Journal of Attention Disorders*, *11*(6), 689-699.

Raffaelli, M., & Crockett, L. J. (2003). Sexual risk taking in adolescence: The role of self-regulation and attraction to risk. *Developmental Psychology*, *39*(6), 1036.

Ramrakha, S., Bell, M. L., Paul, C., Dickson, N., Moffitt, T. E., & Caspi, A. (2007). Childhood behavior problems linked to sexual risk taking in young adulthood: A birth cohort study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*(10), 1272-1279.

Ramanathan, N., Swendeman, D., Comulada, W. S., Estrin, D., & Rotheram-Borus, M. J. (2013). Identifying preferences for mobile health applications for self-monitoring and self-management: Focus group findings from HIV-positive persons and young mothers. *International Journal of Medical Informatics*, *82*(4), e38-e46.

Rawlings, D., Boldero, J., & Wiseman, F. (1995). The interaction of age with impulsiveness and venturesomeness in the prediction of adolescent sexual behaviour. *Personality and Individual differences*, *19*(1), 117-120.

Rooney, M., Chronis-Tuscano, A., & Huggins, S. (2012). Disinhibition mediates the

    relationship between ADHD and problematic alcohol use in college students.

    Journal of Attention Disorders, 19(4), 313-327.

Rooney, M., Chronis-Tuscano, A., & Yoon, Y. (2011). Substance use in college students

    with ADHD. *Journal of Attention Disorders, 16*(3), 221-234.

Sarver, D. E., McCart, M. R., Sheidow, A. J., & Letourneau, E. J. (2014). ADHD and

    risky sexual behavior in adolescents: Conduct problems and substance use as

    mediators of risk. *Journal of Child Psychology and Psychiatry*, *55*(12), 1345-

    1353.

Schoenfelder, E. N., & Kollins, S. H. (2015). Topical review: ADHD and health-risk

    behaviors: Toward prevention and health promotion. *Journal of Pediatric

    Psychology*, jsv162.

Steiger, J. H. (1998). A note on multiple sample extensions of the RMSEA fit index.

    Structural Equation Modeling, *5*, 411-419.

Steiger, J. H. & Lind, J. C. (1980). *Statistically based tests for the number of factors*.

    Paper presented at the annual spring meeting of the Psychometric Society, Iowa

    City, IA.

Sujan, A. C., Humphreys, K. L., Ray, L. A., & Lee, S. S. (2014). Differential association

    of child abuse with self-reported versus laboratory-based impulsivity and risk-

    taking in young adulthood. *Child Maltreatment, 19*, 145-155.

Tarter, R. E., Kirisci, L., Mezzich, A., Cornelius, J. R., Pajer, K., Vanyukov, M., ... &

    Clark, D. (2003). Neurobehavioral disinhibition in childhood predicts early age at

onset of substance use disorder. *American Journal of Psychiatry. 160*(6), 1078-1085.

Toplak, M. E., Bucciarelli, S. M., Jain, U., & Tannock, R. (2008). Executive functions: Performance-based measures and the behavior-rating inventory of executive function (BRIEF) in adolescents with attention deficit/hyperactivity disorder (ADHD). *Child Neuropsychology*, *15*(1), 53-72.

Tseng, M. H., Henderson, A., Chow, S. M., & Yao, G. (2004). Relationship between motor proficiency, attention, impulse, and activity in children with ADHD. *Developmental Medicine & Child Neurology*, *46*(6), 381-388.

Turchik, J. A., & Garske, J. P. (2008). Measurement of sexual risk taking among college students. *Archives of Sexual Behavior, 38*, 936-948.

Turchik, J. A., Walsh, K., & Marcus, D. K. (2015). Confirmatory validation of the factor structure and reliability of the sexual risk survey in a large multiuniversity sample of US students. *International Journal of Sexual Health*, *27*(2), 93-105.

Upadhyaya, H. P., & Carpenter, M. J. (2008). Is attention deficit hyperactivity disorder (ADHD) symptom severity associated with tobacco use?. *American Journal on Addictions*, *17*(3), 195-198.

Upadhyaya, H. P., Rose, K., Wang, W., O'Rourke, K., Sullivan, B., Deas, D., & Brady, K. T. (2005). Attention-deficit/hyperactivity disorder, medication treatment, and substance use patterns among adolescents and young adults. *Journal of Child & Adolescent Psychopharmacology*, *15*(5), 799-809.

van Emmerik-van Oortmerssen, K., van de Glind, G., van den Brink, W., Smit, F., Crunelle, C. L., Swets, M., & Schoevers, R. A. (2012). Prevalence of attention-

deficit hyperactivity disorder in substance use disorder patients: a meta-analysis
and meta-regression analysis. *Drug and Alcohol Dependence*, *122*(1), 11-19.

Wåhlstedt, C., Thorell, L. B., & Bohlin, G. (2008). ADHD symptoms and executive
function impairment: Early predictors of later behavioral
problems. *Developmental Neuropsychology*, *33*(2), 160-178.

Weafer, J., Milich, R., & Fillmore, M. T. (2011). Behavioral components of impulsivity
predict alcohol consumption in adults with ADHD and healthy controls. *Drug and
Alcohol Dependence*, *113*(2), 139-146.

Weyandt, L. L. (2009). Executive functions and attention deficit hyperactivity
disorder. *The ADHD Report*, *17*(6), 1-7.

Weyandt, L. L. (2005). Executive function in children, adolescents, and adults with
attention deficit hyperactivity disorder: Introduction to the special issue.
Developmental Neuropsychology, *27*(1), 1-10.

Weyandt, L. L. & DuPaul, G. J. (2013). *College students with ADHD: Current status and
future directions*. New York, NY: Springer.

Weyandt, L. L., & DuPaul, G. (2006). ADHD in college students. *Journal of Attention
Disorders*, *10*(1), 9-19.

Weyandt, L. L., Oster, D. R., Gudmundsdottir, B. G., DuPaul, G. J., & Anastopoulos, A.
D. (2017). Neuropsychological functioning in college students with and without
ADHD. *Neuropsychology*, *31*(2), 160.

Weyandt, L. L., Willis, W. G., Swentosky, A., Wilson, K., Janusis, G. M., Chung, H. J., .
. . Marshall, S. (2014). A review of the use of executive function tasks in

externalizing and internalizing disorders. In S. Goldstein & J. A. Naglieri (Eds.). *Handbook of Executive Functioning*. New York, NY: Springer.

Wilens, T. E., & Biederman, J. (2006). Alcohol, drugs, and attention-deficit/hyperactivity disorder: a model for the study of addictions in youth. *Journal of Psychopharmacology*, *20*(4), 580-588.

Wilens, T. E., Martelon, M., Joshi, G., Bateman, C., Fried, R., Petty, C., & Biederman, J. (2011). Does ADHD predict substance-use disorders? A 10-year follow-up study of young adults with ADHD. *Journal of the American Academy of Child & Adolescent Psychiatry*, *50*(6), 543-553.

Wilens, T. E., & Spencer, T. J. (2010). Understanding attention-deficit/hyperactivity disorder from childhood to adulthood. *Postgraduate Medicine*, *122*(5), 97-109.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. *Biological psychiatry*, *57*(11), 1336-1346.

Wolf, L. E., Simkowitz, P., & Carlson, H. (2009). College students with attention-deficit/hyperactivity disorder. *Current Psychiatry Reports*, *11*(5), 415-421.

Zucker, R. A. (2006). Alcohol use and the alcohol use disorders: A developmental-biopsychosocial systems formulation covering the life course. In: Cicchetti D, Cohen DJ, editors. Developmental psychopathology: Vol. 3. Risk, disorder and adaptation. 2nd. New York, NY, pp. 620–656.

Table 1. *Participants by Sex, Race, and Ethnicity*

Category	n	Percent
Sex		
Male	192	46.7
Female	219	53.3
Race		
Caucasian	296	72.0
African American	48	11.7
Asian	24	5.8
Bi – or Multiracial	14	3.4
Other	29	7.1
Ethnicity		
Non-Hispanic/Latino	367	89.3
Hispanic/Latino	44	10.7

Table 2. *Means and Standard Deviations of ADHD Symptomatology (i.e., ADHD-IA Sx. and ADHD-HI Sx.), Externalizing Symptomatology (ODD Sx. and CD Sx.), Executive Function (Behavior Regulation and Metacognition), Sexual Risk Behavior (Sexual Risk Taking with Uncommitted Partners, Risky Sex Acts, Impulsive Sexual Behaviors, Intent to Engage in Risky Sexual Behaviors, and Risky Anal Sex Acts), and Substance Use (Stimulant Use, Depressant Use, and Other Drug Use).*

Indicator Variables	Mean	SD	Skewness	Kurtosis
ADHD-IA Sx.	62.1000	18.80	0.291	-1.113
ADHD-HI Sx.	51.88	15.49	0.655	-0.504
ODD Sx.	6.100	4.259	0.727	-0.110
CD Sx.	0.859	1.577	4.350	31.67
Behavioral Regulation	52.49	12.56	0.595	-0.473
Metacognition	56.53	13.71	0.443	-0.663
Sexual Risk Taking with Uncommitted Partners	4.951	6.170	1.518	1.873
Risky Sex Acts	3.885	3.899	1.043	0.635
Impulsive Sexual Behaviors	4.710	4.918	1.086	0.463
Intent to Engage in Risky Sexual Behaviors	1.082	1.794	1.785	2.588
Risky Anal Sex Acts	0.264	1.021	6.876	61.321
Stimulant Use	0.095	0.545	7.030	57.50
Depressant Use	6.385	6.652	1.348	1.286
Other Drug Use	4.000	6.885	2.378	6.156

Table 3. *Pearson Correlation Analyses of ADHD Symptomatology (i.e., ADHD-IA Sx. and ADHD-HI Sx.), Externalizing Symptomatology (ODD Sx. and CD Sx.), Executive Function (Behavior Regulation and Metacognition), Sexual Risk Behavior (Sexual Risk Taking with Uncommitted Partners, Risky Sex Acts, Impulsive Sexual Behaviors, Intent to Engage in Risky Sexual Behaviors, and Risky Anal Sex Acts), and Substance Use (Stimulant Use, Depressant Use, and Other Drug Use).*

| Variable	ADHD-IA Sx.	ADHD-HI Sx.	ODD Sx.	CD Sx.	Behavior Regulation	Metacognition
ADHD-IA Sx.	1					
ADHD-HI Sx.	.761** .001	1				
ODD Sx.	.585** .001	.635** .001	1			
CD Sx.	.273** .001	.277** .001	.445** .001	1		
Behavior Regulation	.665** .001	.725** .001	.724** .001	.336* .001	1	
Metacognition	.775** .001	.668** .001	.577** .001	.330* .001	.781** .001	1
Sexual Risk Taking With Uncommitted Partners	.149** .003	.189** .003	.216** .001	.276* .001	.203** .001	.192** .001
Risky Sex Acts	.193** .001	.169** .001	.153** .002	.191* .001	.229** .001	.199** .001
Impulsive Sexual Behaviors	.080 .105	.105* .034	.112* .026	.275* .001	.107* .031	.103* .038
Intent to Engage in Risky Sexual Behaviors	.099* .044	.087 .078	.084 .096	.272* .001	.052 .297	.076 .127
Risky Anal Sex Acts	.091 .066	.092 .062	.044 .382	.039 .440	.079 .112	.112* .024
Stimulant Use	.105* .035	.048 .340	.075 .142	.162* .001	.103* .038	.087 .079
Depressant Use	.116* .020	.142** .004	.109* .032	.227* 001	.148** .003	.153** .002
Other Drug Use	.164** .001	.132** .008	.133** .009	.265* .001	.205** .001	.186** .001

Notes. * = Correlation is significant at the 0.05 level. ** = Correlation is significant at the 0.01 level

Table 4. *Correlation Analyses From Final Confirmatory Factor Analyses of ADHD Symptomatology (i.e., ADHD-IA Sx. and ADHD-HI Sx.), Externalizing Symptomatology (ODD Sx. and CD Sx.), Executive Function (Behavior Regulation and Metacognition), Sexual Risk Behavior (Sexual Risk Taking with Uncommitted Partners, Risky Sex Acts, Impulsive Sexual Behaviors, and Intent to Engage in Risky Sexual Behaviors), and Substance Use (Stimulant Use, Depressant Use, and Other Drug Use)*

| Latent Variables	1	2	3	4	5
1. ADHD Symptomatology	1				
2. Externalizing Symptomatology	0.743*	1			
3. Executive Dysfunction	0.913*	0.809*	1		
4. Substance Use	0.186*	0.225*	0.208*	1	
5. Sexual Risk Behavior	0.220*	0.203*	0.272*	0.745*	1

Note. * = Correlation is significant at the 0.05 level.

Figure 1. *Confirmatory Factor Analysis Model of ADHD Symptomatology (i.e., ADHD-IA Sx. and ADHD-HI Sx.), Externalizing Symptomatology (ODD Sx. and CD Sx.), Executive Function (Behavior Regulation and Metacognition), Sexual Risk Behavior (Sexual Risk Taking with Uncommitted Partners, Risky Sex Acts, Impulsive Sexual Behaviors, and Intent to Engage in Risky Sexual Behaviors), and Substance Use (Stimulant Use, Depressant Use, and Other Drug Use)*
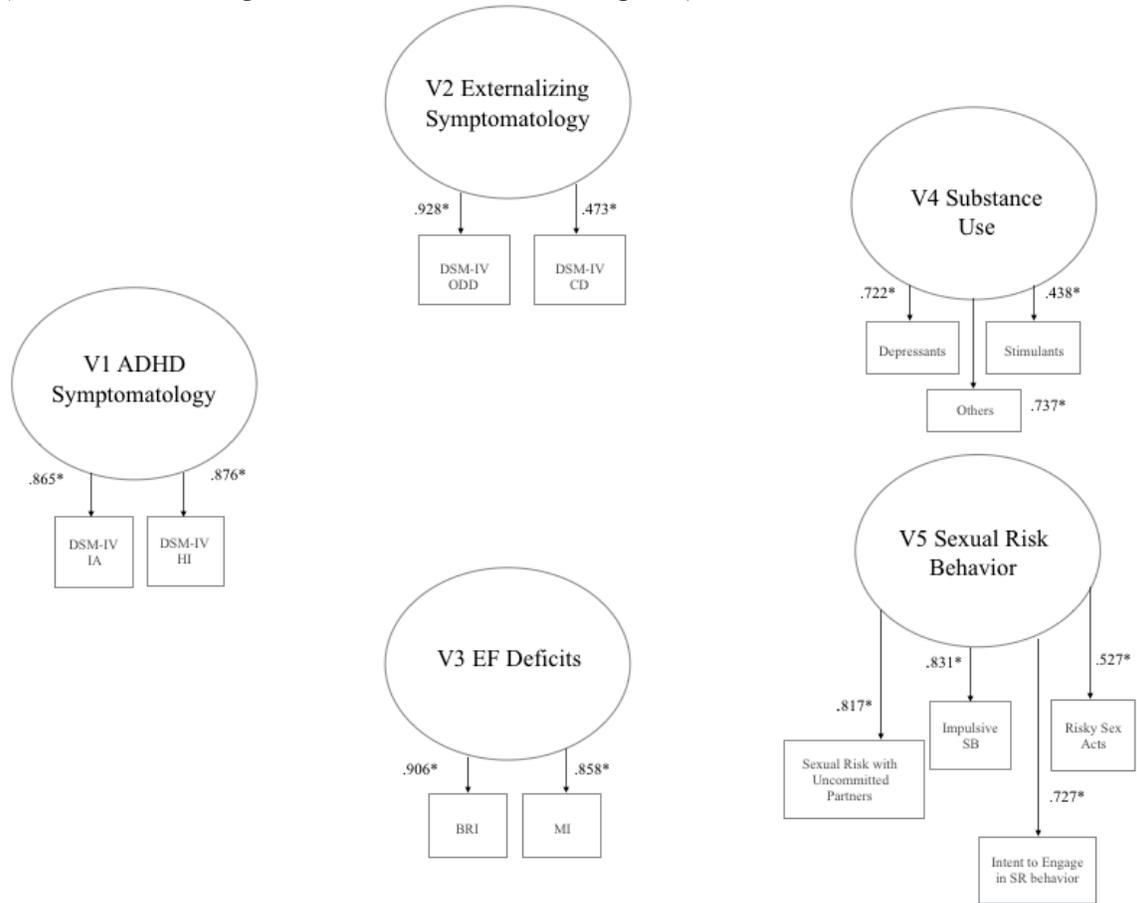
Note. * = All factor loadings are statistically significant, *p* < .001.

Figure 2. *Depiction of the proposed direct latent variable model with one independent, latent variable, ADHD symptomatology, as measured by the DSM-IV inattention (IA) symptom subscale and the hyperactive-impulsive (HI) symptom subscale, on the CAARS (V1), two proposed latent mediators, externalizing symptomatology, as measured by the two symptom dimensions (i.e., ODD and CD), on the EBRS (V2), and EF deficits as measured by the BRI and MI scales on the BRIEF (V3), and two latent, dependent variables, substance use as measured by three drug classifications, which are comprised of the ten substances on the ASSIST (V4), and sexual risk behavior as measured by the four subscales on the SRS (V5).*
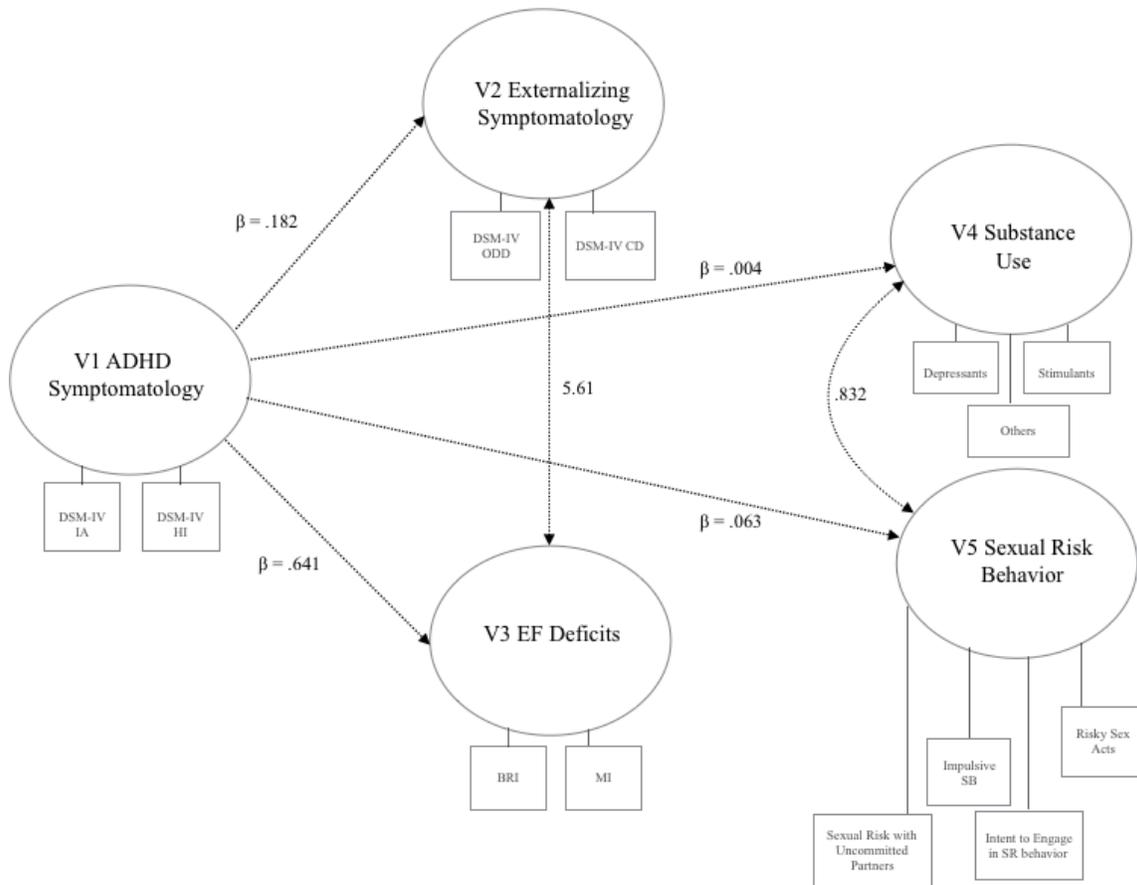
χ^2 (59, N= 390) = 321.416, $p < 0.00100$, RMSEA = 0.107, CFI = 0.900, 90%CI [0.095, 0.118]

Appendix A

Detailed Description of Variables of Interest

- Independent variable: ADHD symptomatology, as measured by the *DSM-IV* inattention (IA) symptom subscale and the hyperactive-impulsive (HI) symptom subscale, on the CAARS.

- Mediator variable: Externalizing symptomatology, as measured by the two symptom dimensions (i.e., ODD and CD), on the EBRS.

- Mediator variable: EF deficits, as measured by the BRI and MI scales on the BRIEF.

- Dependent variable: Substance use, as measured by three drug classifications (i.e., stimulants, depressants, or other), which are comprised of the ten substances on the ASSIST.

- Dependent variable: Sexual risk behavior, as measured by the five subscales on the SRS.