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OUTCOMES AND PREDICTORS OF PRESCRIPTION STIMULANT MISUSE IN COLLEGE STUDENTS WITH AND WITHOUT ADHD

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BY

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ABSTRACT

In recent years, rates of prescription stimulant misuse have increased substantially among young adults ages 18-25 (Chen et al., 2016). Although research exploring correlates of prescription stimulant misuse has increased in recent years, several gaps in the literature remain. With preliminary studies that suggest students with ADHD may be more likely to misuse their stimulant medication than their non-ADHD peers (Janusis & Weyandt, 2010), research is needed to further explore this topic as well as possible rates, predictors, and outcomes of prescription stimulant misuse among college students with and without ADHD. Therefore, the purpose of the present study was to examine rates of prescription stimulant medication misuse among undergraduate students with and without ADHD and the relationship between misuse of prescription stimulants, academic behaviors (i.e. study strategies), psychological factors (i.e., anxiety, depression, inattention), and academic performance (i.e., GPA).

The current sample was comprised of college students from several public and private universities within the US (N = 144). Results revealed a statistically significant difference in rates of misuse among college students with ADHD compared to their non-ADHD peers, with higher rates of misuse among males compared to their female counterparts. With depression and anxiety entered into the predictive model, inattentive symptoms were the only significant predictor of misuse in the full sample. ADHD group membership did not have a significant effect on the model. Study skills were not predictive of prescription stimulant misuse among the current sample. In terms of academic performance, symptoms of anxiety and inattention significantly predicted GPA and neither depression nor ADHD were significant in the model. Low motivation and

poor test strategies were also significantly predictive of GPA while concentration and ADHD group membership were not, when entered into the same model. Importantly, prescription stimulant misuse did not moderate the relationship between study skills and GPA or psychological variables and GPA.

The present findings have implications for academic interventions aimed at supporting the success of college students with and without ADHD, and help inform academic outcomes of prescription stimulant misuse. Limitations of the study and suggestions for future research are discussed.

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PREFACE

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Outcomes and Predictors of Prescription Stimulant Misuse in College Students with and Without ADHD

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Introduction

In recent years, prescription stimulant misuse, defined as the nonmedical use of prescription stimulants (NMUPS) for purposes other than prescribed (Weyandt et al., 2014), has increased substantially among college students without Attention Deficit Hyperactivity Disorder (ADHD) in the United States and abroad (Dussault & Weyandt, 2013; Gudmundsdottir, Weyandt, & Ernudottir, 2016; McCabe, West, Teter, & Boyd, 2014; SAMHSA, 2018; Verdi, Weyandt, & Zavras, 2014; Weyandt et al, 2013). According to the 2017 National Survey on Drug Use and Health, 7.4% of young adults aged 18-25 years old reported past year prescription stimulant misuse, with other researchers reporting prevalence rates as high as 42% of college students (Advokat, Guildry, & Martino, 2008). An increase in research exploring psychological predictors of stimulant misuse among healthy college students has coincided with increasing trends of misuse in recent years, although few studies have explored predictors and outcomes of misuse among college students with ADHD compared to their non-ADHD peers.

Based on preliminary analyses that suggest students with ADHD may be more likely than their non-ADHD peers to misuse their stimulant medication (Benson et al., 2018; Gudmundsdottir et al., 2016), future studies are needed to explore similarities and differences in rates and correlates of prescription stimulant misuse among college students with and without ADHD. Therefore, the present study had three aims. First, to examine rates of misuse of prescription stimulant medication among undergraduate students with and without ADHD. Next, to explore the relationship between misuse of prescription stimulants, academic behaviors (i.e. study strategies), psychological factors (i.e., anxiety, depression, inattention), and academic performance (i.e., GPA). Lastly, to

explore the moderating effect of prescription stimulant misuse on academic outcomes as measured by GPA.

Prescription Stimulant Use and Misuse

Prescription stimulant medication (e.g., Ritalin, Adderall, Concerta) is the most common treatment for college students with Attention Deficit Hyperactivity Disorder (ADHD) (Centers for Disease Control and Prevention [CDC], 2019). ADHD, a neurodevelopmental disorder characterized by clinically significant symptoms of hyperactivity, inattention, and impulsivity (APA, 2013), is estimated to affect 5% of the general population, and between 2-8% of college students in the US (Green & Rabiner, 2012; Weyandt & DuPaul, 2012). Since the effectiveness of prescription stimulants for the management of ADHD symptoms was first discovered in 1937 (Bradley, 1937), several types of prescription stimulants have been approved by the U.S. Food and Drug Administration (FDA) for treatment of symptoms in children, adolescents, and adults.

When used as prescribed, prescription stimulants host an array of benefits without significant health risks to individuals (Advokat, 2009; Findling & Dogin, 1998). However, research documents various adverse effects associated with misuse including, but not limited to, dizziness, dry mouth, headache, insomnia, nausea, tolerance, and withdrawal (Greydanus, 2006; PDR, 2019). In addition, serious potential risks associated with excessive dose include cardiovascular failure, irregular heartbeat, high blood pressure, and paranoia (Volkow, 2005). Prescription stimulants are classified by the Drug Enforcement Agency (DEA) as Schedule II medications (along with codeine, morphine, and oxycontin) (Drug Enforcement Administration, U.S. Department of Justice, 2015) due to a high potential for abuse if not taken as prescribed that may lead to psychological

and/or physiological dependence. Deleterious side effects of misuse and the possibility of abuse and dependence call attention to a need for research exploring correlates and outcomes of misuse of these prescriptions.

Longitudinal research indicates that as many as 80% of children with ADHD continue to manifest symptoms into adulthood (Cheung et al., 2015). Pharmacological treatment is commonly recommended as a form of treatment for youth and adults with ADHD (Barkley & Fischer, 2018; Davidson, 2008; Weyandt, 2017; Weyandt & DuPaul, 2012) and has increased in use over recent years. For example, in 2011 Rozenbroek and Rothstein found that 7% of college students with ADHD had valid prescriptions for stimulant medication, an increase from 2% in 2006 (McCabe et al., 2006). This increase in prevalence has made prescription stimulants more available on college campuses in recent years (Weyandt & DuPaul, 2012) and has coincided with an increase in prescription stimulant misuse among college students without ADHD (Weyandt et al., 2013; Gudmundsdottir & Weyandt, 2016). Misuse of prescription stimulants among college students is particularly problematic as stimulant medications have been found to have a high ratio of nonmedical to medical use (Schulenberg et al., 2018). Moreover, recent rates of past year prescription stimulant misuse have surpassed those of past year opioid misuse as the most commonly misused prescription (SAMHSA, 2018).

In 2018, the Substance Abuse and Mental Health Services Administration (SAMHSA) published that young adults between the ages of 18–25 years old reported the highest rates of non-medical prescription stimulant (NMPS) use (SAMHSA, 2018). Research suggests college students in this age group are twice as likely to report NMPS use than their same aged peers not enrolled in college (Johnston et al., 2008). Findings

from a national survey found that approximately 7% of the students surveyed from 119 4-year colleges, reported using prescription stimulants for non-medical purposes in their lifetime (McCabe, Knight, Teter, & Wechsler, 2005). Furthermore, in 2009, among a sample of 390 college students, Weyandt and colleagues (2009) found 7.5% of the sample reported using stimulants without a valid prescription in the past 30 days. More recent studies have further supported an increasing rate of prescription stimulant misuse among college students within the United States and internationally (Gudmundsdottir et al., 2016; Marraccini, Weyandt, Rossi, & Gudmundsdottir, 2016; Munro, Weyandt, Marraccini, & Oster, 2017; Verdi et al., 2014). In a recent review of the literature, Benson, Flory, Humphreys, and Lee (2015) found the rate of stimulant medication misuse among college students in the USA was estimated at 17%, although similarities and differences between those with ADHD and those without were not explored.

Stimulant Misuse Among College Students with ADHD

Generally, research supports that college students with ADHD are at an increased risk for substance use (e.g., cigarettes, alcohol, cocaine, and stimulants) compared to their non-ADHD peers (Wilens et al., 2008; Mochrie, Whited, Cellucci, Freeman, & Corson, 2018). Research exploring prescription stimulant misuse among college students with ADHD is limited, but several studies suggest stimulant misuse and diversion (i.e., selling, trading, or offering prescription stimulants to others) (Mccabe, Teter, & Boyd, 2004) exist among those with a valid prescription. For example, among a sample of college students with ADHD, 25% reported ever using their medication to “get high”, while 29% reported ever giving their medication to someone else (Upadhyaya et al., 2005). Weyandt

et al. (2009) also found 5.3% of their sample of college students with ADHD reported being “occasionally pressured into giving someone else their prescription stimulants”.

According to previous research, rates of misuse may differ dependent upon ADHD and prescription status. Among a nationally representative sample of young adults, higher rates of prescription stimulant misuse were found among those who reported a legitimate prescription for ADHD medication in the past year or in their lifetime. Among the sample of young adults with ADHD, productivity was reported as the primary motivator for misuse (Novak, Kroutil, Williams, & Van Brunt, 2007), similar to motives found among college students without ADHD. Among their sample of undergraduates from a public university, Benson and colleagues (2018) found participants were 1.11 times more likely to report academic motives for misuse for each additional symptom of ADHD they endorsed on a self-report measure of symptomatology. Preliminary findings such as these, suggest college students with ADHD may be at greater risk for misuse of prescription stimulants, with or without a valid prescription.

Risk Factors and Motivators of Prescription Stimulant Misuse

Several demographic characteristics of those who misuse prescription stimulants have been identified through previous research. Specifically, compared to their non-using peers, students who misuse stimulants are more likely to belong to a fraternity or sorority (Dussault & Weyandt, 2011; Bavarian et al., 2015), have used other illicit substances (McCabe et al., 2005), and have a lower GPA (Weyandt et al., 2013; Benson et al., 2015). In addition, researchers have found self-reported family income (SES) was associated with higher misuse among college students, with higher family income associated with

misuse (Arria et al., 2013). With regard to sex differences, most studies have reported males as more likely to misuse prescription stimulants than females (Benson et al., 2018; Chen et al., 2016; Garnier-Dykstra et al., 2012; Rabiner et al., 2009). Conversely, others have found no difference in misuse between males and females (Dussault & Weyandt, 2013; Bavarian et al., 2017), and others have even suggested a decrease in gender differences compared to previous years (Bavarian, Flay, Ketcham, & Flay, 2013).

Psychological Predictors of Prescription Stimulant Misuse

Low and Gendaszek (2002) were among the first to explore psychological correlates of "psychostimulant use" among the college population, with an emphasis on sensation-seeking and perfectionism. Although perfectionism was not associated with psychostimulant use, results suggested that students who rated high in sensation-seeking were more likely to use prescription stimulants. More current research has identified several additional psychological factors associated with prescription stimulant misuse including symptoms of inattention (Arria et al., 2011; Rabiner et al., 2009), depression (Teter, Falone, Cranford, Boyd, & McCabe, 2010), and anxiety (Dussault & Weyandt, 2013; Verdi et al., 2014; Weyandt et al., 2009). Furthermore, in a correlational study of 414 college students, Weyandt et al. (2009) found college students who reported higher rates of stimulant misuse also reported a higher degree of internal restlessness and psychological distress related to somatization, obsessions and compulsions, sensitivity, depression, anxiety, hostility, phobia, paranoia, and psychoticism. Research exploring psychological predictors of stimulant misuse has increased over recent years, yet no studies have explored psychological predictors among college students with ADHD

compared to their non-ADHD peers. Furthermore, few studies have explored collectively the predictive power of psychological variables.

Academic Motives of Stimulant Misuse

Academic motives, including help with concentration in class, help with homework completion, and increased performance on tests are most commonly cited as motivators for stimulant misuse among college students (Arria et al., 2008; Benson et al., 2015; Weyandt et al., 2009; 2013). In a systematic review of the literature, Weyandt and colleagues (2013) found that more than 15 studies documented academic enhancement as a reason for students' reported misuse. Specifically, students most commonly reported using prescription stimulants to enhance focus or alertness, improve academic performance, and perform better on schoolwork (Bossaer et al., 2013; Marraccini et al., 2016; Weyandt et al. 2009).

Although students also report the use of stimulants for socialization purposes, academic motives consistently outweigh self-report of recreational or weight loss motives (Benson et al., 2015). For example, among a sample of 3,400 undergraduates at one public and one private university in southeastern US, 54% of nonmedical users used ADHD medication exclusively for academic reasons, while 6% misused ADHD medication exclusively for nonacademic reasons (Rabiner et al., 2009). More recently, Bavarian and colleagues (2017) reported 47% of their sample of college students from a university in Northern California reported misuse "to experiment", 34.7% "to party longer," and 8.6% "to lose weight". Among their sample, "to improve focus" and "to improve concentration" was reported by 78.8% of participants. With limited research regarding prescription stimulants as a study aid and academic enhancer, it is unclear

whether college students who misuse prescription stimulants are benefiting academically. Importantly, few studies support the effectiveness of stimulant misuse for academic and cognitive enhancement among the general population, yet these continue to be the primary motivator reported for prescription stimulant misuse (Weyandt et al., 2018).

Stimulants as a Neurocognitive Enhancer

Research exploring the effects of stimulant medication on cognitive performance provides modest evidence for improved cognition following use. For example, in a review of 36 placebo-controlled studies assessing neurocognitive outcomes, small-to-moderate positive effects for memory, reaction time, reaction time variability, and response inhibition were found among children and adolescents with ADHD given methylphenidate, a stimulant commonly prescribed for ADHD (Coghill et al., 2013). Similarly, in a systematic meta-analysis, Marraccini et al. (2016) found prescription stimulant medication had positive effects on processing speed accuracy, but no effect on planning time, planning accuracy, advantageous decision-making, or cognitive perseveration.

Pertaining to college students, among those with and without ADHD, Weyandt et al. (2017) found stimulant medication was associated with improved outcomes on neuropsychological tasks measuring executive functioning (EF), specifically impulsivity and sustained attention. Similarly, in a double-blind placebo study of the efficacy and safety of a prescription stimulant medication (lisdexamfetamine dimesylate [LDX]) among college students with ADHD, LDX was associated with improved EF and reductions in ADHD symptoms across participants with ADHD (DuPaul et al., 2012). Conversely, in exploring the effects of a prescription stimulant (Adderall) among healthy

young adults (i.e., without ADHD), Ilieva, Boland, and Farah (2013) found improvement on few neuropsychological tasks, although participants reported perceiving the drug as enhancing their cognition. More recently, in a pilot study of healthy college students without ADHD, Weyandt and colleagues (2018) found mixed effects of Adderall on cognitive performance, including *impairment* on working memory, *improvement* in attention, and no enhanced effects on reading performance. Importantly, analyses revealed large effect sizes of Adderall on activated emotion and autonomic activation. Findings such as these suggest college students without ADHD who engage in stimulant misuse experience significant increases in emotion and autonomic activation following Adderall consumption, but may not experience the cognitive enhancement some seek.

With a high percentage of students reporting prescription stimulant misuse for academic enhancement (Advokat et al., 2008; Bossaer et al., 2013; Rabiner et al., 2009; Weyandt et al., 2009) it is important to explore the effects of stimulant misuse on academic outcomes. Although research in this area is limited, Munro, Weyandt, Marraccini, and Oster (2016) explored the role of non-medical use of prescription stimulants (NMUPS) on the relationship between executive function (EF) and academic performance. Findings revealed that NMUPS did not have a significant effect on academic outcomes as measured by GPA, although EF deficits were associated with lower GPA and greater prescription stimulant misuse. These findings suggest prescription stimulant misuse may not provide the academic boost college students often desire. However, based on research that suggests prescription stimulants enhance some aspects of cognitive functioning, it is plausible that misuse of prescription stimulants may play a role in the relationship between psychological functioning, study strategies, and GPA. It

is therefore important to explore these and other variables that may be affecting academic outcomes and prescription stimulant misuse.

Academic Success in College Students

A robust body of research supports an association between study strategies and academic achievement among college students (e.g., Griffen, MacKewn, Moser, & VanVuren, 2013; Krumrei-Mancuso, Newton, Kim & Wilcox, 2013; McKenzie, Gow, & Schweitzer, 2004; Van Staden & Ellis, 2017). Weinstein and colleagues (2000) defined learning strategies as "any thoughts, behaviors, beliefs or emotions that facilitate the acquisition, understanding or later transfer of new knowledge and skills" (Weinstein, Husman, & Dierking, 2000, p. 727). Importantly, several strategies such as intrinsic motivation, self-discipline (Griffin at al., 2013), self-regulation (McKenzie et al., 2004), and stress and time management (Krumrei-Mancuso et al., 2013) have been identified as correlates of academic success in college.

Research suggests college students employ various study strategies when preparing for lectures and exams, including self-testing and rereading (Hartwig & Donlosky, 2012). Use of specific strategies have been found to differ between college students with ADHD, those with learning disabilities (LD), and those without disabilities (Reaser, Prevatt, Patcher, & Proctor, 2007). Moreover, Gormley and colleagues (2018) reported significant differences in study strategies between college students with ADHD compared to their non-ADHD peers. With research suggesting study strategies are associated with academic outcomes (Hartwig & Dunlosky, 2012), differences in study strategies between groups can have implications for college success in undergraduate students. Because primary motivators for misuse of prescription stimulants include

neurocognitive and academic enhancement (Arria & Wish, 2006; Dussault and Weyandt, 2013; Weyandt et al., 2009), it is important to examine the relationship between prescription stimulant misuse and study strategies. Further, with evidence that psychological factors predict prescription stimulant misuse, the role of psychological functioning in academic performance should be addressed.

Previous research suggests psychological functioning may affect college students' academic success through two avenues—the decision to remain in school, and productivity or performance when enrolled in school (Eisenberg, Golberstein, & Hunt, 2009). Anxiety and depression have been linked to lower academic performance in childhood and adolescence (Owens, Stevenson, Hadwin, & Norgate, 2012), with less research exploring the impact of anxiety and depression on academic functioning among college students. Of the limited research that exists, the majority of studies have focused on the impact of test anxiety on academic performance. Among those findings, a negative correlation between test anxiety and overall academic achievement is generally supported (e.g., Chapel et al., 2005; Brady, Hard, & Gross, 2018).

Similarly to anxiety, clinical depression is often associated with difficulty concentrating (APA, 2013) and intrusive ruminating thoughts (Nolen-Hoeksema, 2000), symptoms that appear to impact academic performance. In their work with school children, Owen et al. (2012) found anxiety and depression were both associated with increased worry about test-taking, which influenced working memory, and lowered test performance. Results of a follow-up study suggested the association between negative affect and academic performance was driven by the link between working memory and academic performance (Owen et al., 2012). Although less is known about the relationship

between anxiety, depression, and academic achievement among the college population, based on trends observed in childhood and adolescence, it is possible that anxiety and depression have negative effects on academic functioning in college students. With previous research that suggests college students with anxiety and depression are at greater risk for stimulant misuse, the role of stimulant use in academic outcomes among individuals who report anxiety and depression is an area to address.

Purpose of the Study

Previous research lends support for several psychological and social correlates of prescription stimulant misuse in college students, including Greek affiliation, college GPA, illicit drug use, depression, anxiety, and internal restlessness (Bavarian et al., 2015; Benson et al., 2015; McCabe et al., 2005; Weyandt et al., 2013). Similarly, academic enhancement has been cited throughout the literature as a main motivator of prescription stimulant misuse across college campuses (Benson et al., 2018). Of note, preliminary research suggests prescription stimulants may not provide academic or cognitive enhancement among students (Ilieva et al., 2013; Munro et al., 2016; Weyandt et al., 2018), and instead may lead students to simply perceive enhanced abilities when using the substance (Ilieva et al., 2013). Thus, the purpose of the present study is to examine undergraduate students', with and without ADHD, misuse of prescription stimulant medication, and the relationship between prescription stimulant misuse, academic behaviors (i.e. study strategies), psychological factors (i.e., anxiety, depression, inattention), and academic performance (i.e., GPA).

The present study had three aims. First, to investigate the prevalence of misuse of prescription stimulants among a sample of college students with and without ADHD attending several universities located in Northeastern and Southeastern US. Second, to investigate the relationship between psychological functioning (i.e., depression, anxiety, inattention), academic outcomes (i.e., GPA), and prescription stimulant misuse in college students, exploring potential differences between students with and without ADHD. Third, to investigate the relationship between study strategies (i.e., concentration,

motivation, and self-testing) employed among college students with and without ADHD, academic outcomes (i.e., GPA), and prescription stimulant misuse.

Research Hypotheses

Based on previous research, the following hypotheses were advanced:

1. Prescription stimulant misuse would be reported among the sample, with statistically significant higher rates of misuse reported among college students with ADHD compared to those without ADHD.
2. Higher rates of depression, anxiety, and inattention would be predictive of prescription stimulant misuse among college students with and without ADHD. Lower rates of concentration, motivation, and test strategies would be predictive of prescription stimulant misuse among college students with and without ADHD.
3. Higher rates of depression, anxiety, and inattention would be predictive of lower academic outcomes as measured by GPA for college students with and without ADHD. Further, prescription stimulant misuse would moderate the relationship between psychological functioning and GPA. Lower rates of study strategies would be predictive of lower academic outcomes as measured by GPA, and prescription stimulant misuse would moderate the relationship between study skills and GPA for students with and without ADHD.

Method

Study Procedure

This study was part of the Trajectories Related to ADHD in College (TRAC) project, a 5-year multisite longitudinal investigation aimed at determining the functional trajectories (e.g., educational, behavioral, social, vocational) of college students with ADHD relative to those without ADHD. Three primary sites were involved, including one university in the Southeast and two universities in the Northeast United States. The final sample of the TRAC project consisted of 456 students recruited in two cohorts (51.8% female, 67.5% non-Hispanic Caucasian; see Anastopoulos et al. 2015, for a full description of the sample and procedures). Of these, 144 students (62 ADHD, 82 non-ADHD; 82 Female, 57 Male) were eligible for use in the current study due to their completion of a final questionnaire.

Participants

The participants for this study (N = 144) included fourth year college students between 18 and 25 years of age (M = 21.32, SD = .481), from the TRAC project. Eligibility criteria for the ADHD group were based on a multi-gated screening method. First, either students or their parents had to endorse at least four symptoms of ADHD during childhood and during the last 6 months. Next, all students were required to meet full *Diagnostic and Statistical Manual of Mental Disorders* (5th ed; DSM-5) diagnostic criteria (APA, 2013) for ADHD on a semi-structured interview. To be included in the comparison group (i.e., non-ADHD), participants and their parents could endorse no more than three symptoms of ADHD on the retrospective childhood ratings scale and the current (6-month) rating scale. In addition, participants could endorse no more than three

symptoms of ADHD on the semi-structured interview. All potentially eligible cases were then reviewed by a panel of four ADHD experts. Unanimous panel agreement was required for a final group classification (i.e., ADHD v "control"). There were no significant differences between ADHD and control groups based on age, gender, socioeconomic status, and racial or ethnic diversity.

Measures

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

Prescription stimulant use/misuse. Abbreviated Stimulant Survey Questionnaire (SSQ). Stimulant use, misuse, and perceptions were measured using the abbreviated SSQ. The SSQ is a 40-item questionnaire that was designed to measure the use and misuse of prescription stimulant medications in college students (Weyandt et al., 2009). Preliminary analyses suggest the scale has adequate internal consistency ($\alpha = .849$) (Weyandt et al., 2009). The abbreviated version includes 10 of the original 40 items designed to measure the use and misuse of prescription stimulant medications as well as knowledge of prescription stimulant use on a 5-point Likert scale with *1=Never* and *5=Always*. For the purpose of this study, misuse (0 = no, 1 = yes) was defined by a rating greater than 1 on any three of the SSQ items ($\alpha = .65$), specifically, "I have used prescription stimulants for non-medical purposes", "I have taken prescription stimulants to feel better about myself", and "I have tried someone else's prescription stimulant medication." For several

analyses, items were combined to measure severity of misuse on a scale of 3 = *Never* and 15 = *Always*.

ADHD Symptomatology. Conner's Adult ADHD Rating Scale, Self-Report, Long Form (CAARS-S:L). To assess current ADHD symptomatology, the Conners' Adult ADHD Rating Scale (CAARS) was administered. The CAARS-S:L (Conners, Erhardt, & Sparrow, 1998) is a 66-item self-report measure of adult ADHD symptoms that is commonly used in research and clinical practice. The CAARS-S:L is psychometrically sound with a diagnostic sensitivity of 82%, specificity of 87%, and an overall diagnostic efficiency rate of 85% (Erhardt, Epstein, Conners, Parker & Sitarenios, 1999). The measure is standardized, allowing for normative data comparisons. Respondents rate items pertaining to their behavior experiences using a 4-point Likert-type scale for each item. Responses range from 0 (*not at all, never*) to 3 (*very much, very frequently*).

The CAARS-S:L 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). Separate symptom severity scores are divided into three groups—inattention/memory problems, hyperactivity/restlessness, and impulsivity/emotional lability. 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 was used to assess the severity of ADHD symptoms across groups in the present study.

Learning and Study Strategies. Learning and Study Strategies Inventory (LASSI; Weinstein, Schulte, & Palmer, 1987). Study strategies were assessed using the college version of the LASSI. Based on the general model of learning and cognition (Simon, 1979) and a model of strategic learning (Weinstein, 1994), the LASSI is a self-report instrument to assess learning strategies. The 80-item scale consists of ten subscales including Time management, Anxiety, Concentration, Information Processing, Selecting Main Ideas, Study Aides, Self-Testing, and Test Strategies. Each subscale is composed of 8 to 10 statements measured on a 5-point Likert scale (*a= not at all typical of me, e= very typical of me*). The reliability of the subscales is adequate, ranging from .68 (study aides) to .85 (Time Management). Similarly, test-retest reliability ranges from .72 (Information processing) to .85 (Time Management and Concentration) (Weinstein et al., 1987). For the present study, 3 of the 10 scales were used, based on a preliminary correlational analysis. Specifically, concentration, motivation, and test strategies.

The concentration scale of the LASSI assesses students' ability to direct and maintain attention on academic tasks. Low scores on this scale suggest students may need to improve their levels of concentration through techniques to redirect themselves and eliminate interference. The motivation scale of the LASSI assesses students' diligence, self-discipline, and willingness to exert the effort necessary to successfully complete academic requirements. Low scores on this scale indicate a need for goal setting and accountability of one's academic performance. Finally, the test strategies scale assesses students' use of test preparation and test taking strategies. Students who score low in this area may need to learn more effective techniques to prepare for taking tests and demonstrating their knowledge.

*Depression***.** *Beck Depression Inventory-II (BDI-II;* Beck, Steer, & Brown, 1996). Depressive symptoms were measured using the BDI-II, a 21-item self-report measure of depression that has been widely used in research and clinical practice. The BDI-II evaluates several key symptoms of depression including mood, pessimism, sense of failure, self-dissatisfaction, guilt, punishment, self-dislike, self-accusation, suicidal ideas, crying, irritability, social withdrawal, indecisiveness, body image change, work difficulty, insomnia, fatigability, loss of appetite, weight loss, somatic preoccupation, and loss of libido (Beck & Steer, 1993; Beck, Steer & Garbing, 1988). Each statement is scored on a 4-point Likert-scale (0 = *least*, 4 = *most)*. Total scores on the BDI-II range from 0-63, with higher scores indicating higher symptom severity. Suggested score ranges for mild depression, moderate to severe depression, and severe depression are 10–19, 20–30, and 31 or higher, respectively (Kendall, Hollon, Beck, Hammen, & Ingram, 1987). The BDI-II has been found to have strong internal consistency among college students (α = .93). Data have also indicated adequate test-retest reliability across multiple studies (Beck et al., 1996; Sprinkle et al., 2002). In this study, the total score from the BDI-II was used as a measure of depressive symptoms.

Anxiety. Beck Anxiety Inventory (BAI; Beck & Steer, 1993). The BAI was used to measure symptoms of anxiety. The BAI is a 21-item self-report scale that measures anxiety in adolescents and adults 17-years-old and older. Individual items are rated on a 4-point Likert scale (0 = *Not at all*, 3 = *Severely*), with a final score of 0-63. BAI scores are classified as minimal anxiety (0-7), mild anxiety (8-15), moderate anxiety (16-25), and severe anxiety (30-63). The BAI has been found to have adequate internal consistency (α = .92) and test-retest reliability (Beck & Steer, 1993; De Ayala,

Vonderharr-Carlson, & Kim, 2005). In this study, the BAI total score was used as a measure of anxiety.

Educational Data. Fourth Year Grade Point Average (GPA). Participants' fourth-year cumulative GPA was primarily collected using archival information from the colleges' Registrar offices. When archival data were not available (e.g., college policy prohibiting the release of academic records) participants were contacted by a research assistant to provide these data via self-report. GPAs were reported on a 4-point scale ranging from 0.0 to 4.0.

Data Analyses

All analyses were conducted using SPSS (version 23; IBM, 2015). Missing data were handled using listwise deletion. Descriptive statistics and chi-square tests were first used to analyze rates of misuse among the sample, as well as potential gender and race differences. To test the first hypothesis that higher rates of misuse would be reported among college students with ADHD, an independent samples t-test was used to assess for group differences (ADHD v non-ADHD), with group status as an independent variable and stimulant misuse as a dependent variable.

To test the second hypothesis that higher rates of depression, anxiety, and inattention would be predictive of prescription stimulant misuse, binary logistic regression models were used. The first set of binary regressions assessed the predictive power of psychological factors (i.e., anxiety, depression, inattentive symptoms), with and without ADHD as a covariate. A separate binary logistic regression model was used to test the hypothesis that poor concentration, motivation, and test strategies would be predictive of prescription stimulant misuse. This set of binary regressions assessed the

predictive power of study strategies (i.e., concentration, motivation, and test strategies), with and without ADHD as a covariate.

Hierarchical regression analyses were used to test the final set of hypotheses. The first hierarchical regression assessed the predictive power of psychological factors (i.e., anxiety, depression, inattentive symptoms) on academic outcomes (i.e., GPA), with and without ADHD as a covariate. A separate hierarchical regression model was used to test the hypothesis that poor concentration, motivation, and test strategies would be predictive of lower academic performance, with and without ADHD as a covariate.

Next, a moderator analysis was conducted with the PROCESS SPSS macro as recommended by Hayes (2013), to test the hypothesis that study strategies would be positively related to academic outcomes as measured by GPA, and prescription stimulant misuse would moderate the relationship between study skills and GPA. In this model, study strategies served as the independent variable, GPA as the dependent variable, and stimulant misuse (yes/no) as the moderator. A second moderator analysis using PROCESS SPSS macro was used to test the hypothesis that higher rates of depression, anxiety, and inattention would be associated with poorer academic outcomes, and prescription stimulant misuse would moderate the relationship. Psychological factors were the independent variable, GPA was the dependent variable, and stimulant misuse (yes/no) was the moderator in this model.

Results

Participant Demographics

A total of 144 individuals in their fourth year of college were included in the analyses. Participants were enrolled at several private and public universities located within Northeastern and Southeastern United States. The majority of participants were female (57%), 40% identified as male and 3.4% did not report their sex. Participants identified as White (72.2%), African American (15.3%), Asian (6.9%), more than 1 race (.7%), and other/not reported (4.9%). With regards to ADHD diagnoses, 42.4% of participants had a clinically significant diagnosis of ADHD. Grade point average (GPA) ranged from 2.00 to 4.00, with a mean GPA of 3.17 (SD = 0.49).

Descriptive Statistics

Prevalence of lifetime prescription stimulant misuse in the included sample was 32.6%. Significant differences between males and females were supported, $X^2(1, N = 144) = 8.892$, $p = .003$. Specifically, 23.2% of females and 47.4% of males reported prescription stimulant misuse (Table 1). Significant differences across race was not supported ($p = .430$). A substantial number of participants endorsed having taken prescription stimulants to perform better in schoolwork (42.3%), having been offered prescription stimulants by other students (40.3%), and trying someone else's prescription stimulant medication (24.3%). Almost half of participants (41%) agreed that prescription stimulants were easy to get on their campus; however, about the same (42.4%) neither agreed nor disagreed.

Prevalence of Misuse Across Groups

To test the first hypothesis that students with ADHD would report prescription stimulant misuse more than students without ADHD, an independent samples T-test was conducted with one dichotomous independent variable (ADHD/Non-ADHD) and one continuous dependent variable for misuse. Means and standard deviations (SD) are shown in Table 2. Results revealed statistically significant group differences, $t(142) = 3.967$, $p < .000$, $d = .668$, 95% CI [0.329, 1.007]. The group with ADHD had higher scores on the combined items of the abbreviated self-reported Prescription Stimulant Misuse Questionnaire ($M = 4.403$, S$D = 1.796$) compared to the group without ADHD ($M = 3.463$, $SD = 1.020$) (Table 2). This finding indicates that students with ADHD reported higher rates of using prescription stimulants for non-medical purposes (i.e., "I have used prescription stimulants for non-medical purposes", "I have taken prescription stimulants to feel better about myself", and/or "I have tried someone else's prescription stimulant medication").

Psychological Predictors of Prescription Stimulant Misuse

To estimate the association between psychological variables and stimulant misuse, a binary regression was conducted with the three psychological characteristics as independent variables in the same model (Table 3). A second logistic regression included ADHD as a covariate. In the unadjusted model, greater inattentive symptoms were associated with higher odds of prescription stimulant misuse (OR = 1.08, 95% CI [1.05, 1.13], $p < .001$), while anxiety and depressive symptoms were not significantly associated with prescription stimulant misuse. With ADHD entered into the model as a covariate, inattentive symptoms remained as the only significant predictor of stimulant misuse (OR = 1.09, 95% CI [1.05, 1.15], $p<.001$). Of note, when depressive symptoms

(OR = 1.05, 95% CI [1.00, 1.09], p< .05) and anxiety (OR = 1.04, 95% CI [1.00, 1.09], p <.05) were entered into the equation alone, they significantly predicted prescription stimulant misuse, although they were no longer significant when inattentive symptoms and ADHD were entered as predictors and covariates.

Academic Predictors of Prescription Stimulant Misuse

A similar approach was used to estimate the independent association between study strategies and stimulant misuse (Table 4). Specifically, the three study strategies were entered as independent variables in the same model. A second logistic regression included ADHD as a covariate. In both models, concentration, motivation and test strategies were not significantly predictive of prescription stimulant misuse.

Psychological Predictors of Academic Performance (GPA)

Next, separate hierarchical linear regression models addressed the total portion of GPA explained by psychological well-being and study strategies explored in the current study (Table 5). The first set of hierarchical linear regressions addressed the total portion of GPA explained by psychological factors. The first step, which included depressive symptoms, significantly predicted GPA, $F(1, 120) = 6.419$, $p < .05$. This model predicted 4% of the variance in GPA (adjusted $R^2 = .043$) and the presence of depressive symptoms accounted for a reduction in GPA of .012. The second step added anxiety and significantly predicted GPA, $F(2, 119) = 8.81$, $p < .001$. This model predicted 11% of the variance in GPA, which is a significant improvement from the original model (adjusted $R^2 = .114$, $p < .001$). In this model, depression was no longer a significant predictor ($p = .831$), although the presence of anxiety accounted for a reduction in GPA of .021. The third step added inattentive symptoms and significantly predicted GPA, $F(3, 118) =$

10.259, p <.001. This model predicted 19% of the variance in GPA and improved upon the previous models (adjusted R^2 = .187, p < .001). The presence of anxiety symptoms was associated with a significant reduction in GPA by .02 points and the presence of inattentive symptoms was associated with a significant reduction in GPA by .01 points. The final model added ADHD to the list of predictors. Although the model was significant, $F(4, 117) = 7.752$, $p < .001$, and predicted 18% of the variance in GPA, the inclusion of ADHD status did not significantly improve the model (adjusted R^2 = .182, p < .001).

Next, follow up moderator analyses were conducted to explore the potential impact of stimulant misuse on GPA. Three separate models were run. The first moderation analysis examined the main and potentially moderating effects of anxiety and stimulant misuse on GPA, controlling for depressive symptoms, inattentive symptoms, and ADHD. A significant main effect was detected for prescription stimulant misuse, b = -.262, SE = 0.127, t = -2.07, p < .05, 95% CI [-0.513, -0.011], and anxiety, b = -.024, SE = 0.008, t = -3.080, p = <.05, 95% CI [-.039, -0.009]. The interaction between stimulant misuse and anxiety symptoms was nonsignificant, b = .018, SE = 0.011, t = 1.628, p = .106, 95% CI [-.004, .039].

The second moderation analysis examined the main and moderating effects of depression and stimulant misuse on GPA, controlling for anxiety, inattentive symptoms, and ADHD. In this model, neither main effect was significant. The interaction between depressive symptoms and stimulant misuse was also nonsignificant, b = 0.004, SE = 0.009, t = -.044, p = .665, 95% CI [-0.019, 0.018].

A third moderation analysis examined the main and interactive effects of inattentive symptoms and stimulant misuse on GPA, controlling for anxiety, depressive symptoms, and ADHD. A significant main effect was detected for prescription stimulant misuse, b = -.775, SE = 0.367, t = -2.111, p < .05, 95% CI [-1.503, -0.047], and inattention, b = -.012, SE = 0.047, t = -2.559, p = <.05, 95% CI [-0.021, -0.027]. The interaction between stimulant misuse and inattentive symptoms was nonsignificant, b = 0.011, SE = 0.006, t = 1.827, p = .070, 95% CI [-0.001, 0.024].

Academic Predictors of Academic Performance (GPA)

The final set of regression analyses addressed the total portion of GPA explained by study strategy variables in this study (Table 6). The first step, which included concentration, significantly predicted GPA, $F(1, 120) = 30.128$, $p < .001$. This model predicted 19% of the variance in GPA (adjusted $R^2 = .194$) and the presence of low concentration accounted for a reduction in GPA of .007. The second step added motivation and significantly predicted GPA, $F(2, 119) = 25.976$, $p < .001$. This model predicted 29% of the variance in GPA, which is a significant improvement from the original model (adjusted $R^2 = .292$, p <.001). In this model, concentration was no longer a significant predictor (p =.184), although the presence of low motivation accounted for a reduction in GPA of .007. The third step added test strategies and significantly predicted GPA, $F(3, 118) = 21.029$, p <.05. This model predicted 33% of the variance in GPA and improved upon the previous models (adjusted $R^2 = .332$, $p < .001$). The presence of low motivation was associated with a reduction in GPA by .005 points and the presence of poor test strategies was associated with a reduction in GPA by .006 points. Finally, ADHD was added to the list of predictors. Although the model was significant, $F(4, 117)$

= 15.761, $p < .001$, and predicted 33% of the variance in GPA, the inclusion of ADHD status did not significantly improve the model (adjusted $R^2 = .328$, $p < .001$).

Follow up moderation analyses were conducted to explore the potential impact of stimulant misuse on study strategies and GPA. Again, three separate models were run. The first moderation analysis examined the main and interactive effects of concentration and stimulant misuse on GPA, controlling for motivation, test-strategies, and ADHD. The main effects of concentration ($p = .678$) and stimulant misuse ($p = .932$) were nonsignificant, although significant effects were found for test strategies ($p = .004$). The interaction between concentration and stimulant misuse was also nonsignificant, $b = -0.0042$, $SE = 0.003$, $t = -.817$, $p = .415$, 95% CI [-0.008, 0.003].

A second moderation analysis examined the main and interactive effects of motivation and stimulant misuse on GPA, controlling for test-strategies, concentration, and ADHD. No significant main effects were found for motivation ($p = .07$) or stimulant misuse ($p = .629$), although significant effects were found for test-strategies ($b = .006$, $SE = .002$, $t = 2.994$, $p < .05$, 95% CI [.002, .010]) The interaction between motivation and stimulant misuse was nonsignificant, $b = -.000$, $SE = 0.003$, $t = -.149$, $p = .881$, 95% CI [-.006, 0.005].

A final moderation analysis examined the main and interactive effects of test-strategies and stimulant misuse on GPA, controlling for motivation, concentration, and ADHD. A significant main effect was found test strategies ($b = .007$, $SE = .002$, $t = 2.944$, $p < .05$, 95% CI [.002, .022], but not stimulant misuse ($b = -.005$, $SE = .150$, $t = -.034$, $p = 972$, 95% CI [-.303,.293]). A significant effect was also found for motivation ($b = .003$, $SE = .002$, $t = 1.948$, p = .05, 95% CI [-.000, .007]). The interaction between

test strategies and stimulant misuse was nonsignificant, b =-.002, SE = 0.003, t = -.681, p = .498, 95% CI [-.008, 0.004].

Discussion

Given the increasing rates of reported prescription stimulant misuse among college students, it is important to identify possible predictors and outcomes of misuse to aid in greater understanding and preventative measures. While previous research has suggested several psychological predictors of stimulant misuse among the college population, to date, little attention has been paid to study strategies and prescription stimulant misuse among college students. Furthermore, a lack of research exists regarding academic outcomes of prescription stimulant misuse, although academic outcomes are the most commonly reported reason for misuse among college students. To address this gap in the literature, the present study had four aims: 1) explore the prevalence of prescription stimulant misuse among college students with and without ADHD, 2) identify predictors of stimulant misuse in college students with and without ADHD, 3) identify predictors of GPA in college students with and without ADHD, and 4) identify the impact of prescription stimulant misuse on academic success as measured by GPA.

Overall, current findings revealed prescription stimulant misuse was reported by 32.6% of the current sample, with significant differences found between sex. Specifically, 23.2% of females and 47.4% of males reported misusing prescription stimulants. Among the females who reported misuse in the current sample, 73.7% had a diagnosis of ADHD. Comparatively, for males who endorsed misuse, 59.3% had an ADHD diagnosis. When SSQ items were explored individually, 25.8% of the sample reported having ever misused, 11.7% of the sample reported having misused “to feel

better" about themselves, and 27.1% reported trying someone else's prescription stimulant medication.

Prevalence rates among the current sample align with those found in several previous studies. For example, Advocat et al. (2008) reported 43% of undergraduate participants from a large southern public university endorsed using prescription stimulants without a valid prescription. More recently, among 199 undergraduate students from a southern US university, Blevins, Stephens, and Abrantes (2017) reported 43.2% of participants endorsed lifetime prescription stimulant misuse. Compared to other research findings, however, rates of misuse reported among the current sample were somewhat higher. Prosek and colleagues (2018), for example, found that 14.15% of their sample from a Southwestern university reported past year misuse. Similarly, Munro et al. (2016) reported a lifetime prevalence rate of 18.8% among students at six public universities located throughout the Northeast, Southeast, Central-Midwest, Northwest, and Southwest regions of the US. These numbers suggest an increase in stimulant misuse over the past decade. For example, Weyandt et al., a decade ago (2009) found 7.5% of participants in their undergraduate student sample reported using stimulants without a valid prescription in the past 30 days. Therefore, it is possible that prescription stimulant misuse has become normative among college students and rates are consequently increasingly.

The rates of misuse reported in the current sample may also be reflective of the methodology of the present study. Specifically, in the present study, misuse was defined as a positive endorsement of one or more of the following statements: "I have used prescription stimulants for non-medical purposes", "I have taken prescription stimulants to feel better about myself," and/or "I have tried someone else's prescription stimulant

medication." Compared to other research designs that measured misuse as a yes/no response to questions such as "Have you ever misused prescription stimulants?" (e.g., Munro et al., 2016), the higher rates of reported misuse in the current study may indicate that college students do not conceptualize their use of prescription stimulants as "misuse". If this is the case--that students are not accurately defining their use of prescription stimulants as misuse-- students may benefit from exposure to information regarding definitions and possible consequences of prescription stimulant misuse.

Another possible explanation for the prevalence rates reported in the present study is characteristics of the sample. Specifically, the current sample was composed of students with and without a current ADHD diagnosis, with significantly higher rates of misuse found among students with ADHD. Therefore, the number of students with an ADHD diagnosis (42.4%) in the current sample may have impacted the overall prevalence of misuse found in the present study. Overall, the number of students who endorsed misuse in the current sample (32.6%) falls within the range of previous findings and highlights a need for interventions addressed at all college students, not just those with ADHD.

The significant difference in rates of misuse found between students with and without ADHD supported the first hypothesis. Among the students surveyed, 50% of those with an ADHD diagnosis reported misusing prescription stimulants while 19.6% of those without a diagnosis reported misusing prescription stimulants. Specifically, college students with ADHD reported having used prescription stimulants for non-medical purposes (29%), having used prescription stimulants to feel better about themselves (27.4%), and having tried someone else's prescription stimulant medication (32.3%).

Again, these findings suggest that some students, including those with ADHD, may not conceptualize their use of prescription stimulants as misuse. Consequently, prescribing clinicians should be mindful of these motives and provide information regarding misuse of prescription stimulants (e.g., definition of misuse for those with a valid prescription, along with possible outcomes) to the clients they serve in an effort to decrease misuse and diversion among the college student population.

Of note, the reports of misuse among college students with ADHD differed from those without ADHD, who only endorsed having used prescription stimulants for non-medical purposes (16.8%) and having tried someone else's prescription stimulant medication (18.1%). Among students without ADHD, 15.6% reported having misused prescription stimulants to perform better on their schoolwork, although this was not considered misuse in the present study given the possible ambiguity of the statement for those with a valid prescription. Interestingly, no participants within the non-ADHD group reported having misused prescription stimulants to feel better about themselves, compared to 27.4% of those with ADHD who endorsed this motive. Accordingly, interventions aimed at decreasing prescription stimulant misuse among college students with ADHD may be most effective with an emphasis on increasing academic self-efficacy, an area of functioning that has been found to be negatively related to ADHD symptom severity (Shifrin, Proctor, & Prevatt, 2010).

Social norms based interventions may be helpful in reducing prescription stimulant misuse among all college students who engage in this behavior. These interventions, founded in social norms theory, work on the premise that young people's risk behavior is based on misperceptions of risk behavior among peers (i.e., typically an

overestimation of peers' engagement in risk behavior (Vallentin-Holbech, Rasmussen, & Stock, 2017)). Systematic reviews have found social norms influences are an important factor in effective school-based drug prevention programs (Reid & Carey, 2015). Moreover, several interventions based on social norms theory have shown promising results in reducing alcohol consumption among university students (Bewick et al., 2013) and harmful drinkers (Bertholet et al., 2016). One way these interventions work is through delivering personalized social norms feedback through web-based programs. Based on students' reported risk behaviors, they receive personalized feedback including the percentage of students who reportedly engaged in lower levels of the risk behavior (e.g., alcohol consumption) and negative effects of the risk behavior reported by other students within the same risk category (Bewick et al., 2013). The goal of such interventions is to demonstrate the discrepancy between personal behavior and the perceived norms of the larger social group (Vallentin-Holbech et al., 2017). The positive results of intervention studies aimed at reducing rates of alcohol use among adolescents and young adults (Bertholet et al., 2016; Bewick et al., 2013; Strøm et al., 2015; Vallentin-Holbech et al., 2017), suggests that similar interventions may be useful in reducing misuse of prescription stimulants among college students.

Significant differences in rates of misuse between those with ADHD and those without, are consistent with previous research findings that those with ADHD are more likely to abuse illicit substances (e.g., Mochrie et al., 2018) and preliminary findings that students with ADHD are more likely to misuse prescription stimulants (Weyandt et al., 2010). Further research is needed to explore motives of misuse among college students with a valid prescription, however, along with the current findings, previous results

provide insight into why students with ADHD may engage in misuse. Advokat, Lane, and Luo (2011) found that among their sample, most college students with ADHD with a valid prescription reported that using prescription stimulants helped them, although they still believed they were worse than other students at planning, completing assignments, and avoiding distractions. Findings such as these lend support for the higher percentage of students with ADHD who reported misusing prescription stimulants to "feel better about myself" among the current sample. Together with findings from previous research, these results highlight a need to assist college students with ADHD with study skills such as planning, concentration, and completing assignments. It is possible, through increasing students' competence in study skills, students may be less likely to turn to prescription stimulant misuse.

Effective academic support services for students with ADHD have been proposed throughout the literature. Specifically, DuPaul and colleagues (2017) found that academic coaching (i.e., an approach focused on fostering meta-cognitive thinking and self-determination) had significant positive effects on GPA across their full sample, with greater effects for students with ADHD. Although to date this has been the only study to explore the effects of academic coaching on GPA among college students with ADHD (i.e., DuPaul et al. 2017), a recent review of the literature found that most research supports a positive effect of coaching on ADHD symptoms and executive function, likely impacting overall academic performance (Ahmann, Tuttle, Saviet, & Wright, 2018). Based on the finding that college students with ADHD reported higher rates of stimulant misuse than their non-ADHD peers, interventions aimed at improving academic performance, such as those posited by DuPaul and colleagues (2017) are sorely needed.

The hypothesis that higher rates of depression, anxiety, and inattentive symptoms would predict stimulant misuse was partially supported. Specifically, when entered into logistic regressions independently, each variable predicted stimulant misuse, although when entered in the same model, only inattentive symptoms remained significant, even when controlling for ADHD diagnosis. These results suggest students with inattentive symptoms, with and without an ADHD diagnosis, are more likely to misuse prescription stimulants and their likelihood of misuse increases as symptom severity increases. In addition, results suggest it is possible the predictive power of depression and anxiety in relation to prescription stimulant misuse is better explained by the inattentive symptoms that accompany these conditions, lending a plausible explanation for significant findings reported in previous research studies that explored these variables individually (e.g., Verdi et al., 2014; Weyandt et al., 2009). Based on these significant findings, future research should further examine the relationship between inattention, anxiety, and prescription stimulant misuse to gain a better understanding of the underlying motives for misuse among students with anxiety.

Although research on the predictive power of inattentive symptoms on stimulant misuse is limited, previous research findings regarding motivations for use lend support for the current findings. Specifically, in a comprehensive review of the literature, Benson, Flory, Humphreys, and Lee (2015) found “to concentrate better while studying” and “to improve concentration” were among the most commonly endorsed motives for misuse among college students. Findings such as these suggest it is possible college students who struggle with inattention are likely self-medicating with prescription stimulants. Future interventions aimed at decreasing prescription stimulant misuse should incorporate

findings regarding inattentive symptoms and offer practical suggestions for students who struggle with concentration. Further, given that sleep problems are common among college students (Becker et al., 2018), educating students about the link between sleep deprivation and cognitive functioning, specifically concentration (Okano, Kaczmarzyk, Dave, Gabrieli, & Grossman, 2019), may be helpful in decreasing prescription stimulant misuse among the college population.

The hypothesis that poor concentration, low motivation, and poor test strategies would predict prescription stimulant misuse was not supported. When entered into the model together, the predictors were not significant, although low motivation and low concentration were predictive of misuse when entered into the model independently. It is possible that the predictive power of the variables when entered together was undetected because of the limited sample size of the present study and these results warrant further investigation. With ADHD entered into the model as a covariate, each predictor (i.e., concentration, motivation, and test strategies) remained nonsignificant.

The next hypothesis that higher rates of depression, anxiety, and inattentive symptoms would be predictive of lower GPA was partially supported. A stepwise regression analysis revealed the full model (depression, anxiety, and inattentive symptoms) was the best fit and predicted 19% of the variance in GPA. The results suggest that college students with higher rates of anxiety and inattentive symptoms are more likely to demonstrate academic difficulties, as measured by GPA. Importantly, in this model, inattentive symptoms were a greater predictor of academic performance compared to anxiety. Such results highlight a need for interventions aimed at better

supporting college students with inattention difficulties, regardless of ADHD diagnosis, as well as anxiety.

While psychosocial interventions aimed at addressing the challenges of adults with ADHD exist and show promising results on improving levels of inattention (e.g., LaCount, Hartung, Shelton, & Stevens, 2018), the literature suggests oftentimes services are not offered through universities or are underutilized by undergraduate students. For example, among college students with ADHD, Chew, Jensen, and Rosén (2009) found only 40% of college students reported that their university offered appropriate accommodations and among those, only 45% reported utilizing the services. The results of the present study highlight a need to increase students' access to and use of academic support services, particularly for those struggling with inattention and anxiety. Currently, a lack of research explores *why* students are not utilizing these services and this is an important area for future research.

Results revealed increasing rates of depressive symptoms were predictive of lower GPA when entered into the model individually, although when anxiety was included as a predictor, depression was no longer significant. According to these results, symptoms of anxiety are a greater predictor of academic performance compared to depressive symptoms. This finding is important to consider in light of the increasing rates of anxiety among college students. Specifically, the American College Health Association (2019) found among a nationally representative sample of college students, 65.7% of participants reported experiencing "overwhelming anxiety" within the past 12 months. Moreover, 27.8% of the sample reported that feelings of anxiety affected their individual academic performance within the same time frame. Importantly, in the same

survey, 16.5% of participants reported being diagnosed or treated for comorbid anxiety and depression within the past 12 months (ACHA, 2019). Based on present findings, academic interventions designed for students with comorbid anxiety and depression are needed and such interventions may be most effective with a greater emphasis on treating symptoms of anxiety that are impeding academic success.

Research exploring the academic outcomes of psychological interventions among college students is limited, although several interventions aimed at reducing anxiety and depressive symptoms among college students have been found effective. For example, Hart Abney, Lusk, Hovermale, and Melnyk (2019) found a cognitive behavioral therapy (CBT) based intervention titled "Creating Opportunities for Personal Empowerment" (COPE), was effective in decreasing anxiety and depressive symptoms among a group of college students. Dear and colleagues (2019) also found a 5-week CBT based internet delivered intervention to be effective in reducing symptoms of anxiety and depression among college students receiving services through a university counseling center. Interventions such as these should be implemented across college campuses, with an emphasis on increasing students' access and engagement, particularly for those with inattentive symptoms and comorbidity.

The final set of hypotheses surrounding the predictive power of study strategies on GPA were also partially supported. Specifically, a stepwise regression analysis revealed the full model (concentration, motivation, and study strategies) was the best fit and predicted 33% of the variance in GPA. In this model, the presence of low motivation and poor test strategies were significantly predictive of GPA, where poor test strategies had higher predictive power. These results highlight a need to support college students

with adopting successful test strategies and increasing students' intrinsic motivation. Based on the items included in the motivation scale of the LASSI, interventions aimed at increasing students' goal setting and self-discipline may prove most beneficial. In addition, helping students adopt effective techniques for preparing for and taking tests should be considered. Importantly, the inclusion of ADHD in this model did not significantly improve or change the model, suggesting ADHD diagnosis did *not* have a significant effect on the relationship between test strategies and GPA, and therefore indicating that *all* students may benefit from such interventions.

Finally, each moderator analysis exploring the potential effect of stimulant misuse on the relationship between psychological predictors and GPA yielded non-significant results. Specifically, reported stimulant misuse did not have a significant effect on the relationship between psychological factors and GPA. The same was true for each moderator analysis involving study strategies, indicating that misuse did not have a significant effect on the strength of the relationship between study skills and GPA. Although the present research did not explore the effects of stimulant misuse on individual assignments and tests, the results suggest that misuse of prescription stimulants does not have a significant effect on cumulative academic success. These findings align with those reported by Arria and colleagues (2017) who concluded that students who engaged in prescription stimulant misuse showed no increase in their GPAs and gained no significant advantage compared to their peers who did not misuse.

The present findings are of particular importance given the robust body of literature suggesting widespread misuse of prescription stimulants among college students for purposes of neurocognitive and academic enhancement (Weyandt et al.,

2013). In a pilot study of the effects of Adderall among healthy college students, the authors concluded that Adderall led to mixed effects, including impairment in cognitive functioning (working memory) and improvement in attentional performance (Weyandt et al., 2018). Similarly, in a meta-analysis, Ilieva et al. (2013) found small, "probably modest", effects of amphetamine and methylphenidate on working memory and inhibitory control in healthy adults. Findings such as these suggest students are not experiencing significant academic enhancement by misusing prescription stimulants, yet academic, along with neurocognitive, enhancement remains as the top motive for misuse among college students.

Collectively, these results indicate a need for interventions aimed at changing college students' behavior around prescription stimulant misuse. The transtheoretical model (TTM) has been used successfully to intervene on a number of health risk behaviors including high fat diet, smoking, and exercise (Greene et al., 2013; Hashemzadeh, Rahimi, Zare-Farashbandi, Alavi-Naeini, & Daei, 2019; Redding et al., 2014; Zhu, Ho, Sit & He, 2014). TTM is a model of intentional behavior change involving five stages: precontemplation (P), contemplation (C), preparation (PR), action (A), and maintenance (M). Key concepts of TTM include stage of change (readiness), decisional balance (e.g., pros and cons of prescription stimulant misuse), temptations, and the process of change. Although TTM has yet to be explored with prescription stimulant misuse, research supports the efficacy of TTM-tailored cessation interventions (Velicer et al. 1993) in various samples and populations (e.g., Aveyard, Massey, Parsons, Manaseki, & Griffin, 2009; Erol, Balci, & Sisman, 2018; Velicer, Prochaska, & Redding, 2006). Based on evidence of TTM as an effective behavior change model, it is possible TTM

can be implemented with high school and college students who endorse prescription stimulant misuse to reduce rates of misuse. Future research should explore the efficacy of the model with such populations.

Education for college students regarding drug expectancies and prescription stimulant misuse is also warranted. Specifically, college students should be informed that preliminary studies suggest prescription stimulants are not a significant neurocognitive or academic enhancer (Ilieva et al., 2013; Marraccini et al., 2016; Weyandt et al., 2018). One possibility for disseminating this information includes postings around college campuses and dormitory buildings, including 24-hour study rooms. High school students may also benefit from dissemination of this knowledge around high school buildings or within health class curricula.

Interventions for students who misuse prescription stimulants to enhance academic performance, rather than adapting their study strategies, are also needed. Such interventions may be implemented at the high school level for students to best prepare them for college success, although the teaching of study skills at the college level may also be valuable for students. Study skills are best learned through practice and trial and error (Cottrell, 2008), and therefore, these should be integral pieces of the intervention. The limited research in this area revealed promising results. Specifically, a recent study exploring the effectiveness of early intervention tutoring and training in time management and study skills found the intervention improved college students' final exam scores by 6.5-7.5 percentage points (Gordanier, Hauk, & Sankaran, 2019). Research should continue to explore options to help students who turn to prescription

stimulant misuse as a form of academic enhancement, improve their academic functioning instead.

In attempt to reduce prescription stimulant misuse among college students, several potential barriers should be noted. First, previous research suggests college students enjoy the way prescription stimulants make them feel. Weyandt et al. (2018), found significant drug-induced changes in activated emotion and subjective drug effects from Adderall among a sample of young adults without an ADHD diagnosis. Moreover, although neurocognitive enhancement in areas such as working memory (Weyandt at el., 2018), planning time, planning accuracy, advantageous decision-making, or cognitive perseveration (Marracinni et al., 2016) is not supported through previous research, misuse of Adderall has been found to improve attention (Weyandt et al., 2018). These results suggest a dissociation between effects of prescription stimulants on emotional activation and neurocognition. When engaged in misuse, students experience positive emotions, improved attention, and perceived improvements in performance. Improved attention, likely impacts students' ability to complete work. Misuse among students may also be exacerbated by improvement in processing speed accuracy as reported by Marraccini et al., (2016) in a meta-analysis. Results of the present study, along with others (e.g, Arria et al., 2017; Munro et al., 2016), suggest these improvements do not have significant effects on overall academic success. These findings can be used to combat the potential barriers to decreasing stimulant misuse among college students.

Limitations and Future Directions

Several limitations of the study should be noted. Although the sample was geographically diverse, nearly 80% of the research participants reported their race as Caucasian, therefore impacting the ability to draw conclusions regarding potential differences across race and ethnicities and impacting the generalizability of results across race and ethnicities. Secondly, comparisons across universities that participated in the study were limited due to de-identification of particular sites. In addition, given the limited sample size of students with ADHD, the present study may be underpowered to detect further significant differences between ADHD and non ADHD participants. However, based on preliminary findings, future research should specifically explore between group differences with a larger sample to assess for predictive differences in study strategies between college students with and without ADHD. Such research can help inform interventions to support college students as a whole, as well as help identify any unique needs of those with ADHD.

Next, the abbreviated version of the SSQ retains only ten of the original 40 items of the full scale. While the 10-item measures provides insight into the prevalence of misuse, the full scale can provide additional information regarding motives for misuse. Given the findings of the present study, future research should recruit more diverse samples with regard to race, ethnicity, and gender identity, using the full scale SSQ to further explore predictors and outcomes of prescription stimulant misuse among college students. In addition, given the significant number of college students with and without ADHD who are reportedly misusing prescription stimulants, prevention and intervention

efforts need to be implemented at universities in the US and abroad (Gudmundsdottir et al., 2016; Marraccini et al. 2016; Munro et al., 2017; Verdi et al., 2014).

Finally, 23% of the ADHD sample in the present study reported feeling pressured into letting other students have their prescription stimulant medication (i.e., sharing their medication). Although diversion was not considered misuse for the current analyses, this finding warrants further investigation to inform prevention efforts in decreasing access to prescription stimulants across college campuses. Similarly, the present study did not include a variable to capture prescription status (i.e., current and/or history of a valid prescription) and future research should examine the potential role of prescription status in prescription stimulant misuse to design more targeted prevention and intervention programs.

Conclusion

The current study was among the first to explore the relationship between prescription stimulant misuse, psychological functioning, study skills, and academic outcomes among college students, with an emphasis on prescription stimulant misuse as a potential moderator. Unlike previous research, prescription stimulant misuse was measured as endorsement of one or more of the following statements: "I have used prescription stimulants for non-medical purposes", "I have taken prescription stimulants to feel better about myself", and "I have tried someone else's prescription stimulant medication." A substantial percentage, 32.6%, of college students in the sample reported misuse of prescription stimulants, with a statistically significant higher rate of misuse reported among male participants. Significantly higher rates of misuse were also reported among college students with ADHD compared to their non-ADHD peers, as hypothesized.

Compared to anxiety and depression, inattention was the strongest predictor of prescription stimulant misuse among the current sample, lending support for the second hypothesis. However, contrary to the third hypothesis, study skills (i.e., concentration, motivation, and self-testing) did not significantly predict prescription stimulant misuse. In regards to academic success, again, inattentive symptoms were the greatest predictor of cumulative GPA, although symptoms of anxiety were also a significant predictor of GPA. Specifically, higher rates of inattention and higher rates of anxiety were predictive of lower cumulative GPA among the sample. Importantly, prescription stimulant misuse did not moderate the relationship between psychological functioning and GPA. Low

motivation and poor test strategies were also predictive of cumulative GPA, however, prescription stimulant misuse did not moderate this relationship either.

The present findings have important implications for supporting college students' academic success. Many college students report misusing prescription stimulants as an academic and neurocognitive enhancer, although a significant moderating effect of prescription stimulant misuse was not found. Based on these results, support for students in areas that have been found to predict misuse and academic success, specifically, inattention, anxiety, motivation, and test strategies, is needed. In addition, college students should be informed about the lack of evidence to support prescription stimulant misuse as an academic enhancer as well as the potential side effects of misuse.

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Table 1. Participant Demographics

			Nonmedical use of prescription stimulants			
	Total		No		Yes	
Category	N	Percent	N	Row %	N	Row %
Sex						
Female	82	56.9%	63	76.8%	19	23.2%
Male	57	39.5%	30	52.6%	27	47.4%
Other/not reported	5	3.4%	4	80%	1	20%
Race						
Caucasian	104	72.2%	71	68.3%	33	31.7%
African American	22	15.3%	15	71.4%	6	28.6%
Asian	10	6.9%	5	50%	5	50%
>1 Race	1	.7%	1	50%	1	50%
Other/not reported	7	4.9%	5	71.4%	2	28.6%
ADHD Diagnosis						
Yes	62	43.1%	31	50%	31	50%
No	82	56.9%	66	80.4%	16	19.6%

Table 2. Reported Stimulant Misuse Between Students with ADHD and Students without ADHD

Group	*N*	M	SD	SE	*t*	*p*
ADHD	62	4.403	1.796	.228	3.967	<.001
Non-ADHD	82	3.463	1.020	.113		

Table 3. Logistic Regression- Psychological Predictors of Prescription Stimulant Misuse

Variables	B	S.E.	Wald	df	*p*	OR	95% CI
Model 1							
Constant	-5.579	1.004	30.864	1	.000	.004	
BAI	-.024	.035	.466	1	.495	.977	.912-1.045
BDI	.008	.030	.069	1	.793	1.008	.950-1.069
Inattention	.089	.019	22.581	1	<.001	1.093	1.054-1.134
Psuedo R^2	.267						
Constant	-6.008	1.899	10.004	1	.002	.002	
BAI	-.023	.035	.451	1	.502	.977	.913-1.046
BDI	.007	.030	.058	1	.810	1.007	.949-1.069
Inattention	.093	.024	15.264	1	<.001	1.097	1.047-1.150
ADHD	.145	.541	.072	1	.789	1.156	.400-3.337
Psuedo R^2	.267						

Note: Psuedo R^2 found by averaging the Cox and Snell R-square and the Nagelkerke R-square

Table 4. Logistic Regression- Study Strategies and Prescription Stimulant Misuse

Variables	B	S.E.	Wald	df	p	OR	95% CI
Model 1							
Constant	.683	.370	3.404	1	.065	1.980	
Motivation	-.009	.009	1.007	1	.316	.991	.975, 1.008
Concentration	-.019	.010	3.475	1	.062	.981	.962, 1.001
Test Strategies	-.005	.010	.200	1	.655	.995	.975, 1.016
Psuedo R^2	.183						
Model 2							
Constant	1.294	.663	3.805	1	.051	3.648	
Motivation	-.009	.009	1.184	1	.277	.991	.974, 1.004
Concentration	-.013	.011	1.291	1	.256	.987	.965, 1.009
Test Strategies	-.004	.010	.148	1	.700	.996	.976, 1.017
ADHD	-.553	.495	1.247	1	.264	.575	.218, 1.518
Psuedo R^2	.160						

Note: Psuedo R^2 found by averaging the Cox and Snell R-square and the Nagelkerke R-square

Table 5. Multiple Regression- Psychological Predictors of Academic Outcomes

Variables	*t*	*p*	β	F	df	p	Adj R^2
Model 1							
Overall model				*6.149*	*1, 120*	*.013*	*.043*
BDI	-2.534	.013	-.225				
Model 2							
Overall model				*8.811*	*2, 119*	*.000*	*.114*
BDI	.213	.831	.024				
BAI	-3.269	.001	-.375				
Model 3							
Overall model				*10.259*	*3, 118*	*.000*	*.187*
BDI	1.051	.294	.119				
BAI	-2.689	.008	-.301				
Inattention	-3.404	.001	-.319				
Model 4							
Overall model				*7.752*	*4, 117*	*.000*	*.182*
BDI	1.031	.305	.117				
BAI	-2.641	.009	-.297				
Inattention	-2.468	.015	-.279				
ADHD	.625	.534	.065				

Table 6. Multiple Regression- Study Strategies and Academic Outcomes

Variables	*t*	*p*	β	F	df	*p*	Adj R^2
Model 1							
Overall model				*30.128*	*1, 120*	*.000*	*.194*
Concentration	5.489	.000	.448				
Model 2							
Overall model				*25.976*	*1, 119*	*.000*	*.292*
Concentration	1.335	.184	.141				
Motivation	4.201	.000	.444				
Model 3							
Overall model				*21.029*	*3, 118*	*.000*	*.332*
Concentration	-.430	.668	-.053				
Motivation	2.884	.005	.332				
Test Strategies	2.838	.005	.361				
Model 4							
Overall model				*15.761*	*4, 117*	*.000*	*.328*
Concentration	-.118	.907	-.016				
Motivation	2.842	.005	.318				
Test Strategies	2.876	.005	.369				
ADHD	-.567	.572	-.059				

Figure 1. Depiction of Proposed Moderator Analysis of Psychological Functioning

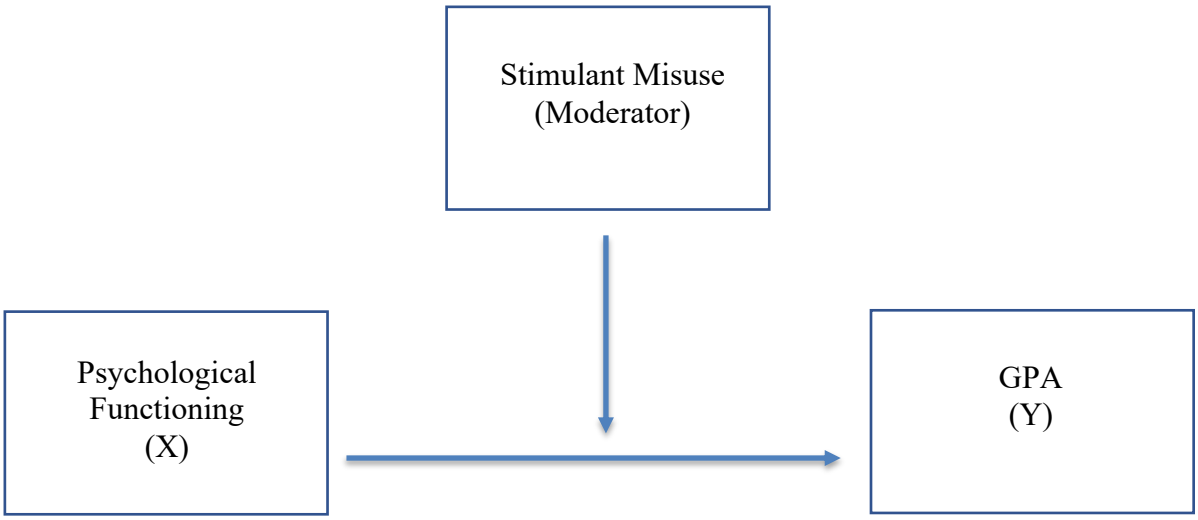
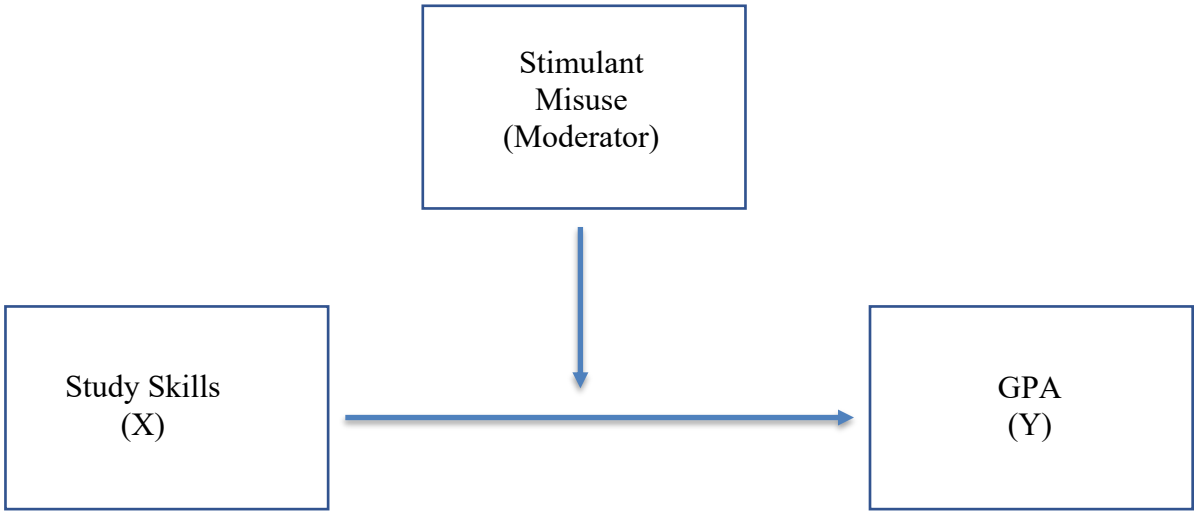


Figure 2. Depiction of Proposed Moderator Analysis of Study Skills



Appendix A

Abbreviated Stimulant Survey Questionnaire

Please answer the following questions about your college experience truthfully.

Stimulants refer to prescription medications including methylphenidate (Ritalin, Concerta, Metadate) and amphetamine (Adderall, Dexedrine, Desoxyn).

Please circle the number that best describes your agreement with each statement.

	Never	**Rarely**	**Occasionally**	**Frequently**	**Always**
1. I have used prescription stimulants for non-medical purposes.	1	2	3	4	5
2. I have taken prescription stimulants to perform better in my school work.	1	2	3	4	5
3. I have taken prescription stimulants to feel better about myself.	1	2	3	4	5
4. I have been offered prescription stimulants by other students.	1	2	3	4	5
5. I have tried someone else's prescription stimulant medication.	1	2	3	4	5
6. I have been pressured into letting someone else have my prescription stimulant medication.	1	2	3	4	5

Please circle the number that best describes your agreement with each statement.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
7. Prescription stimulants are easy to get on this campus.	1	2	3	4	5
8. Using prescription stimulants daily is harmless.	1	2	3	4	5
9. Prescription stimulant use on campus is a problem.	1	2	3	4	5
10. I feel I am knowledgeable about prescription stimulants.	1	2	3	4	5