Article

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

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Abstract

In recent years, rates of prescription stimulant misuse have increased among young adults ages 18 to 25 along with increases in dispensing rates of these medications. Preliminary studies suggest that college students with Attention-Deficit Hyperactivity Disorder (ADHD) may be more likely to misuse their stimulant medication than their non-ADHD peers. Research is needed to further explore possible rates, correlates, and outcomes of prescription stimulant misuse among college students with and without ADHD. Data regarding study strategies, psychological functioning, stimulant misuse, and GPA were collected from students from universities within the US ($N = 144$), showing significantly higher rates of misuse among college students with ADHD. With depression and anxiety entered into the predictive model, inattentive symptoms were the only significant predictor of misuse in the full sample. The present findings have implications for academic interventions aimed at supporting the success of college students with and without ADHD and inform academic outcomes of prescription stimulant misuse.

Keywords

ADHD, prescription stimulants, academic outcome

Objective

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 in the United States and abroad (Dussault & Weyandt, 2013; Gudmundsdottir et al., 2016; McCabe et al., 2014; Substance Abuse and Mental Health Services Administration [SAMHSA], 2018; Verdi et al., 2014; Weyandt et al., 2013). According to the 2017 National Survey on Drug Use and Health, 7.4% of young adults aged 18 to 25 years old reported past year prescription stimulant misuse (SAMHSA, 2018), with other researchers reporting prevalence rates as high as 42% among college students (Advokat et al., 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 stimulant medication (Benson et al., 2018; Gudmundsdottir et al., 2016; Holt et al., 2020; Janusis & Weyandt, 2010), additional 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: to examine rates of misuse of prescription stimulant medication among undergraduate students with and without ADHD; 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); and lastly, to explore the moderating effect of prescription stimulant misuse on academic outcomes as measured by grade point average (GPA).

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Prescription Stimulant Use and Misuse

Prescription stimulant medication (e.g., Ritalin, Adderall, Concerta) is the most common treatment for adults with ADHD (CHADD, 2021), a neurodevelopmental disorder characterized by clinically significant symptoms of hyperactivity, inattention, and impulsivity (American Psychiatric Association [APA], 2013). ADHD is estimated to affect 5% of the general population, and between 2% and 8% of college students in the US (Green & Rabiner, 2012; Weyandt & DuPaul, 2012).

When used as prescribed, prescription stimulants host an array of benefits with minimal health risks to individuals (Advokat, 2009; Ching et al., 2019; Coghill et al., 2014). 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 Staff, 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 (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. Potential 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.

It has been estimated that approximately 7% of college students with ADHD had valid prescriptions for stimulant medication, and it has been demonstrated that the number of prescriptions given, particularly among those aged 20 to 39, is continuing to rise (Board et al., 2020; Rozenbroek & Rothstein, 2011), 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 (Board et al., 2020; Gudmundsdottir et al., 2020; McCabe et al., 2018; Weyandt et al., 2013). 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).

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 (Bavarian et al., 2013; Dussault & Weyandt, 2011), have used other illicit substances (McCabe et al., 2005), have a lower GPA (Benson et al., 2015; Weyandt et al., 2013), and have higher family income (Arria et al., 2013). Concerning sex differences, there is some inconsistency in findings, with most studies reporting that male individuals are more likely to misuse prescription stimulants than female individuals (Benson et al., 2018; Chen et al., 2016; Garnier-Dykstra et al., 2012; Rabiner et al., 2009; Schepis et al., 2020), while others have found no difference in misuse between sexes (Bavarian et al., 2014; White et al., 2006). Interestingly, research suggests a decrease in gender differences in recent years (Bavarian et al., 2013).

Psychological Correlates of Prescription Stimulant Misuse

Research has identified several psychological factors associated with prescription stimulant misuse including symptoms of inattention (Arria et al., 2011; Rabiner et al., 2009), depression (Teter et al., 2010), and anxiety (Dussault & Weyandt, 2013; Verdi et al., 2014; Weyandt et al., 2009). 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. Recently Cole and Hussong (2020) reported that college students with higher levels of impulsivity were most likely to misuse prescription stimulants and Thornton et al. (2020) using the MMPI-2-RF, found that college students who endorsed higher antisocial and behavioral/externalizing scores were more likely to misuse prescription stimulants.

Academic Motives of Stimulant Misuse

Academic motives, including assisting with concentration in class, 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 et al. (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. Interestingly, Gormley et al. (2018) found that among first year college students, study skills were a more salient predictor of educational outcomes relative to ADHD status. However, despite the lack of studies supporting the effectiveness of

stimulant misuse for academic and cognitive enhancement among the general population, the primary motivator reported for prescription stimulant misuse continues to be academic and cognitive enhancement (Compton et al., 2018; Weyandt et al., 2018). Because of the use of prescription stimulants as an academic enhancer, it is pertinent to examine whether individuals with weaker study skills are more likely to turn to prescription stimulant medication as a mechanism to improve academic performance.

Stimulants as an Academic Enhancer

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 relationship between stimulant misuse and academic outcomes. Although research in this area is limited, Munro et al. (2017) explored the role of non-medical use of prescription stimulants (NMUPS) on the relationship between executive function (EF) and academic performance. Findings revealed a lack of relationship between NMUPS and 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 (e.g., Weyandt et al., 2013), it is plausible that misuse of prescription stimulants may play a role in the relationship between psychological functioning, study strategies, and GPA. Given previous preliminary research findings that suggests those who misuse have lower college GPAs than nonusers (e.g., Benson et al., 2015; Lucke et al., 2018), it is important to explore whether misuse of prescription stimulants offers any advantage to college students who are struggling academically.

Aims

The purpose of the present study is to examine misuse of prescription stimulant medication among undergraduate students with and without ADHD, as well as 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). First, we investigated 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, we examined 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, we investigated 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.

Based on previous research, it was hypothesized that college students with ADHD would report significantly higher rates of misuse compared to those without ADHD. It was also hypothesized that higher rates of depression, anxiety, and inattention would be predictive of prescription stimulant misuse among college students with and without ADHD. Additionally, lower rates of concentration, motivation, and test strategies would be related to prescription stimulant misuse among college students, and prescription stimulant misuse was hypothesized to moderate the relationship between psychological functioning and GPA. Lastly, it was predicted that lower rates of study strategies would be correlated with 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. The first-year sample was 51.8% female and 67.5% non-Hispanic Caucasian (see Anastopoulos et al., 2016, 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 inclusion in the current study due to their completion of a final questionnaire, which was administered during the fourth year of the TRAC project. The smaller sample size was due to attrition throughout the 4 years of the larger study. Demographic information regarding the sample utilized in the present study is included below.

Participants involved in the TRAC project, completed the same battery of measures once per year, for 4 years, beginning in their first year of college. Data collection was staggered throughout the fall and spring semesters. In addition, at the conclusion of the study, year 4, students completed an exit interview that included questions regarding prescription stimulant misuse throughout their college career. For the present study, all data was collected during participants' fourth year of the TRAC project.

Participants

The participants for this study ($N=144$) included college students in their fourth year of the TRAC project between 18 and 25 years of age ($M=21.32$; $SD=0.481$). 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 prior 6 months. Next, all students were required to meet full *Diagnostic and Statistical Manual of Mental Disorders* (fifth edition; DSM-5) diagnostic criteria (APA, 2013) for ADHD based 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 (i.e., past 6-months) rating scale. Parent report data was collected for all participants. 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 vs. comparison). There were no significant differences between ADHD and comparison groups based on age, binary gender, socioeconomic status, and racial or ethnic diversity.

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 (56.9%), while 39.5% identified as male and 3.4% did not report their sex as binary male or female. Participants identified as White (72.2%), African American (15.3%), Asian (6.9%), more than one 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) for the total sample ranged from 2.00 to 4.00, with a mean GPA of 3.17 ($SD=0.49$).

Measures

Demographic questionnaire. Students completed a demographic form to indicate their binary 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. Stimulant use, misuse, and perceptions were measured using the abbreviated Stimulant Survey Questionnaire (SSQ); 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 ($\alpha=.699$). 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 ranging from *1=Never* to 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 ranging from 3=*Never* to 15=*Always*.

ADHD symptomology. The Conners' Adult ADHD Rating Scale (CAARS-S:L; Conners et al., 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 et al., 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 ranging from 0 (*not at all, never*) to 3 (*very much, very frequently*). The CAARS-S:L consists of eight subscales and 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. The college version of the Learning and Study Strategies Inventory (LASSI; Weinstein et al., 1987) a self-report instrument to assess learning strategies. The 80-item scale consists of 10 subscales of which three (i.e., concentration, motivation, and test strategies) were used in the current study because they demonstrated the highest correlation with the stimulant misuse variable. Items in the scale inquire about an individual's knowledge and implementation of specific study strategies according to strategic learning strategies. Strategic learning is a method of education which focuses on teaching individuals about specific learning techniques with the goal of increasing educational autonomy through exposure to and usage of these techniques (Boden et al., 2012).

Depression symptoms. Depressive symptoms were measured using the Beck Depression Inventory (BDI-II; Beck et al., 1996), a 21-item self-report measure of depression that has been widely used in research and clinical practice. Each statement is scored on a 4-point Likert-scale (0=*least*, 4=*most)*. Total scores on the BDI-II range from 0 to 63, with higher scores indicating higher symptom severity. 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 symptoms. The Beck Anxiety Inventory (BAI; Beck & Steer, 1993) was used to measure symptoms of anxiety. The BAI is a 21-item self-report scale wherein items are rated on a 4-point Likert scale (0 = *Not at all*, 3 = *Severely*), with a final score range from 0 to 63. The BAI has been found to have adequate internal consistency (α = .92) and test-retest reliability (Beck & Steer, 1993; De Ayala et al., 2005). In the current sample, the BAI was found to have strong internal consistency (α = .92). The BAI total score was used as a measure of anxiety in the present study.

Educational data. 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 Corp, 2015). Missing data, ranging from 0% to 1%, 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 vs. 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. Separate binary regression analyses were utilized to evaluate the relations among psychological factors, study strategies, ADHD, and stimulant misuse. Specifically, psychological factors and study strategies were entered into separate models to address the research questions individually and increase statistical power, given the sample size of the current study.

The first binary regression models 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 related to 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.

Next, a moderator analysis was conducted with the PROCESS SPSS macro as recommended by Hayes (2017) 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

Descriptive Statistics

Prevalence of lifetime prescription stimulant misuse in the included sample was 32.6%. Significant differences between males and females were supported, $X^2(1, N = 144) = 8.89$, $p = .003$. Specifically, 23.2% of females and 47.4% of males reported prescription stimulant misuse, as reported in the SSQ (see Table 1). Significant difference 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.

Rates of Misuse across Groups

To test the first hypothesis that students with ADHD would report greater prescription stimulant misuse 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. Results supported our hypothesis and revealed statistically significant group differences, $t(142) = 3.97$, $p < .001$, Cohen's $d = 0.67$, 95% CI [0.329, 1.007]. Students with ADHD had higher scores on the combined items of the abbreviated self-reported

Table 1. Participant Demographics and Nonmedical Use of Prescription Stimulants.

		Nonmedical use of prescription stimulants			
		No		Yes	
Category	Total *N* (%)	*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 93.4)	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 (0.7)	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	0.228	3.967	<.001
Non-ADHD	82	3.463	1.020	0.113		

Prescription Stimulant Misuse Questionnaire to the group without ADHD (see Table 2).

Psychological Correlates 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 (see 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 Correlates of Prescription Stimulant Misuse

A similar approach was used to estimate the independent association between study strategies and stimulant misuse (see 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, LASSI concentration ($OR = 0.981$, 95 CI [0.962, 1.008]), motivation ($OR = 0.991$, 95 CI [0.975, 1.008]), and test strategies ($OR = 0.995$, 95 CI [0.975, 1.016]) scales were not significantly predictive of prescription stimulant misuse once ADHD was taken into account.

Prescription stimulant misuse as a moderator. 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, $b = -0.262$, $SE = 0.127$, $t = -2.07$, $p < .05$, 95% CI [−0.513, −0.011], and anxiety, $b = -0.024$, $SE = 0.008$, $t = -3.080$, $p = <.05$, 95% CI [−0.039, −0.009]. The interaction between stimulant misuse and anxiety symptoms was nonsignificant, $b = 0.018$, $SE = 0.011$, $t = 1.628$, $p = .106$, 95% CI [−0.004, 0.039].

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

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

Variables	*B*	*SE*	Wald	*df*	*p*	*OR*	95% CI
Model 1							
Constant	−5.579	1.004	30.864	1	.000	0.004	
BAI	−0.024	0.035	0.466	1	.495	0.977	0.912–1.045
BDI	0.008	0.030	0.069	1	.793	1.008	0.950–1.069
Inattention	0.089	0.019	22.581	1	<.001	1.093	1.054–1.134
Psuedo R^2	0.267						
Constant	−6.008	1.899	10.004	1	.002	0.002	
BAI	−0.023	0.035	0.451	1	.502	0.977	0.913–1.046
BDI	0.007	0.030	0.058	1	.810	1.007	0.949–1.069
Inattention	0.093	0.024	15.264	1	<.001	1.097	1.047–1.150
ADHD	0.145	0.541	0.072	1	.789	1.156	0.400–3.337
Psuedo R^2	0.267						

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*	*SE*	Wald	*df*	*p*	*OR*	95% CI
Model 1							
Constant	0.683	0.370	3.404	1	.065	1.980	
Motivation	−0.009	0.009	1.007	1	.316	0.991	0.975, 1.008
Concentration	−0.019	0.010	3.475	1	.062	0.981	0.962, 1.001
Test strategies	−0.005	0.010	0.200	1	.655	0.995	0.975, 1.016
Psuedo R^2	0.183						
Model 2							
Constant	1.294	0.663	3.805	1	.051	3.648	
Motivation	−0.009	0.009	1.184	1	.277	0.991	0.974, 1.004
Concentration	−0.013	0.011	1.291	1	.256	0.987	0.965, 1.009
Test Strategies	−0.004	0.010	0.148	1	.700	0.996	0.976, 1.017
ADHD	−0.553	0.495	1.247	1	.264	0.575	0.218, 1.518
Psuedo R^2	0.160						

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

misuse was also nonsignificant, $b=0.004$, $SE=0.009$, $t=-0.044$, $p=.665$, 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, $b=-0.775$, $SE=0.367$, $t=-2.111$, $p<.05$, 95% CI [−1.503, −0.047], and inattention, $b=-0.012$, $SE=0.047$, $t=-2.559$, $p=<.05$, 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].

Moderation analyses were also 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, $b=-0.0042$, $SE=0.003$, $t=-0.817$, $p=.415$, 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 ($b=0.006$, $SE=0.002$, $t=2.994$, $p<.05$, 95% CI [0.002, 0.010]). The interaction between motivation and stimulant misuse was nonsignificant, $b=-0.000$, $SE=0.003$, $t=-0.149$, $p=.881$, 95% CI [−0.006, 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, $b = 0.007$, $SE = 0.002$, $t = 2.944$, $p < .05$, 95% CI [0.002, 0.022], but not stimulant misuse, $b = -0.005$, $SE = 0.150$, $t = -0.034$, $p = .972$, 95% CI [−0.303, 0.293]. A significant effect was also found for motivation $b = .003$, $SE = 0.002$, $t = 1.948$, $p = .05$, 95% CI [−0.000, 0.007]. The interaction between test strategies and stimulant misuse was nonsignificant, $b = -0.002$, $SE = 0.003$, $t = -0.681$, $p = .498$, 95% CI [−0.008, 0.004].

Discussion

Given the increasing rates of self-reported prescription stimulant misuse among college students, it is important to identify possible correlates of misuse to aid in greater understanding and preventative measures. Although previous research has identified several psychological correlates of stimulant misuse among the college population, to date, little attention has been paid to the relationship between study strategies and prescription stimulant misuse among college students (Dussault et al., 2013). Furthermore, a lack of research exists regarding academic outcomes of those who misuse prescription stimulants, despite academic outcomes being the most commonly reported reason for misuse among college students. The present study addressed these gaps in the literature.

Misuse was defined as "the nonmedical use of prescription stimulants (NMUPS) for purposes other than prescribed" for both groups of students in the present study. Although the specific behaviors underlying misuse between those with ADHD and those without may differ, the use of this definition across groups conceptualizes misuse without an emphasis on behavior (e.g., reserving doses vs. seeking out doses). Previous research suggests motivations for misuse between the two groups align (e.g., Advokat et al., 2008; Bossaer et al., 2013; Herman et al., 2011; McNiel et al., 2011; Rabiner et al., 2009; Weyandt et al., 2009). Specifically, research has found that academic enhancement (e.g., the ability to study outside of class, focus, and concentrate during studying) was consistently the primary motive for misuse among college students with ADHD (Marraccini et al., 2016; Rabiner et al., 2009; Weyandt et al., 2016) and those without an ADHD diagnosis (Herman et al., 2011). Although behaviors between the two groups may differ in terms of misuse, the aim of the present study centered on predictors and outcomes of prescription stimulant misuse, rather than *how* the students misused. Therefore, to best capture the motivators of misuse regardless of how the students misused, the same definition was used across groups based on previous findings.

Overall, current findings revealed prescription stimulant misuse was reported by 32.6% of the current sample, with significant differences found between binary sex (23.2% of females and 47.4% of males). 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. Overall misuse rates among the current sample align with those found in several previous studies. For example, Advokat 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 et al. (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 et al. (2018), for example, found that 14.15% of their sample from a Southwestern university reported past year misuse. Similarly, Munro et al. (2017) 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 the possibility of an increase in stimulant misuse over the past decade. For example, over 10 years ago, Weyandt et al. (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 appears that prescription stimulant misuse has become normative among college students and rates are consequently increasingly.

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%). 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. Recently Molina et al. (2020) found preliminary support for brief clinical practice intervention for primary care providers in reducing diversion of prescription simulants among young adults with ADHD. Further research is warranted in this area.

Of note, in the present study reports of misuse among college students with ADHD differed from those without

ADHD. 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. Further, 18.1% of students without ADHD reported that they had tried someone else's prescription stimulant medication. 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 et al., 2010; Verdi et al., 2019).

The findings regarding ADHD status and the rates and motivations of prescription stimulant misuse are interesting in the context of research pertaining to prescription stimulant misuse during transition from adolescence to young adulthood. Prescription stimulant medication is among the most commonly misused prescription drug among adolescents (Wilens & Kaminski, 2019). Misuse is significantly related to ADHD diagnosis and other substance use, especially other stimulants, such as cocaine (Wilens et al., 2008; Wilens & Kaminski, 2019). The results of the present study are consistent with the finding that an ADHD diagnosis is considered a risk factor for prescription stimulant misuse. Further, it was recently found that 66% of physicians specializing in treatment of ADHD suspect that, in the past year, at least one of their child or adolescent patients wanted stimulants to improve academic performance and 74% of physicians specializing in treatment of ADHD believed that at least one child or adolescent patient feigned symptoms in the past year to obtain an initial ADHD diagnosis and obtain stimulant medication (Colaneri et al., 2020). It has been demonstrated that adolescents and young adults with and without ADHD engage in prescription stimulant misuse, with lifetime diversion rates of individuals with ADHD ranging from 16% to 80% (Faraone et al., 2020; Gallucci et al., 2015; Wilens et al., 2008). In the present study, diversion was not considered a form of misuse, emphasizing the finding that college students with ADHD were more likely to engage in prescription stimulant misuse themselves rather than simply providing the drugs to others. Clearly, more research is needed to help form targeted interventions to reduce prescription stimulant misuse among adolescents and young adults with ADHD.

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., 2016; Weyandt et al., 2009).

These findings are similar to Benson and Flory (2017) who concluded that attention difficulties may be one of the most important factors in predicting stimulant medication misuse. Specifically, Benson and Flory found that symptoms of depression were significantly related to misuse, however, once symptoms of ADHD were included in the statistical analysis, depression was no longer a significant predictor. Their results suggested symptoms of depression that were most related to misuse overlapped with symptoms of ADHD. Specifically, "trouble keeping my mind on what I was doing, inability to focus on the important things, and feeling fidgety" (Benson & Flory, 2017). Symptoms of anxiety, too, often look similar to ADHD and depression symptoms including restlessness and difficulty concentrating (APA, 2013). Previous studies examining anxiety and misuse did not consider ADHD when evaluating this relation (Dussault & Weyandt, 2013; Rabiner et al., 2009; Teter et al., 2010), a gap in the literature that is addressed by the current findings. Future research should explore the specific symptoms of anxiety and their association to prescription stimulant misuse to gain a better understanding of the underlying motives for misuse among students with anxiety.

Finally, each moderator analysis exploring the potential effect of stimulant misuse on the relationship between psychological correlates 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 et al. (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 (Faraone et al., 2020; 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 (e.g., working memory) and improvement in mood and attention performance (Weyandt et al., 2018). Similarly, in a meta-analysis, Ilieva et al. (2013) found small effects of amphetamine and methylphenidate on working memory and inhibitory control in healthy adults. Thus, research to date does not support that students are experiencing significant academic enhancement by misusing prescription stimulants, academic, and 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. Social norms-based interventions may be helpful in reducing prescription stimulant misuse among all college students who engage in this behavior. 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. As mentioned previously, recent studies provide preliminary support for brief interventions with primary care providers at helping to reduce diversion of prescription simulants among young adults with ADHD, however there is a dearth of studies exploring whether similar interventions may be effective with college students who hold valid prescriptions for ADHD medications. Relatedly, 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% to 7.5% points (Gordanier et al., 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 without ADHD perceive stimulants as having beneficial academic and neurocognitive effects and they report enjoying the subjective experience of the effects of prescription stimulant medication. For example, 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. Although substantive neurocognitive enhancement in areas such as working memory planning time, planning accuracy, advantageous decision-making, or cognitive perseveration is not supported by previous research (Marraccinni et al., 2016) prescription stimulants have been found to improve mood states and attention in healthy adults—supporting a dissociation between effects of prescription stimulants on emotional activation and neurocognition (Bagot et al., 2014; Cropsey et al., 2017; Weyandt et al., 2018). For example, Cropsey et al. (2017) found that expecting and receiving stimulants was associated with improved cognitive performance but only on 2 of 31 cognitive tasks. Misuse among students may also be partially driven by improvement in processing speed accuracy as reported by Marraccini et al. (2016) in a recent meta-analysis. Collectively these findings suggest that improvement in mood states, attention, and perceived improvements in performance may be fueling the rates of prescription stimulant misuse among college students including those with and without ADHD. It is important to note that empirical studies are lacking with regard to whether stimulants actually improve a students' ability to complete academic related work as well as the quality of the work produced. In addition, the results of the present study along with others (e.g., Arria et al., 2017; Munro et al., 2017), indicate that improvement found in mood, attention, and in expectations, does not appear to have a significant positive effect on GPA or overall academic success. Importantly, these empirical findings can be used to combat the potential barriers to intervention programs that seek to decrease prescription stimulant misuse among college students.

Limitations and Future Directions

Several limitations of the study should be noted. 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. A recent study exploring prescription stimulant misuse among racially diverse urban adolescents found that 8% of the participants reported misuse within the past year and misuse was associated with greater depression, anxiety, sensation seeking, substance use, and lower parental monitoring (Goodhines et al., 2020). Another limitation to the present study is in the binary definition of sex in terms of "male" and "female," excluding nonbinary and gender nonconforming individuals from the study, and results may not be generalizable to these individuals. In addition, given the limited sample size of students with ADHD due to attrition, the present study may be underpowered to detect further significant differences between ADHD and non-ADHD participants, and the resulting analyses generally yielded small effect sizes. Attrition is particularly problematic because participants who have experienced the worst academic performance are more likely to have dropped out of the study or failed out of school by the fourth year of the study. 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. In particular, the current findings demonstrate that adequate study skills do not make up for difficulties experienced in the domain of concentration, and future research should explore strategies that improve concentration at the college level. 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. Further, the cross-sectional nature of the present study is a major limitation because it does not allow for examination of change in the predictors and correlates as they relate to outcomes, as it is impossible to know whether predictors, such as academic performance, have changed because of prescription stimulant misuse. The cross-sectional nature of this research also prevents the identification of causal relationships. Future longitudinal research is needed to explore the trajectory of predictors of prescription stimulant misuse among students from diverse backgrounds including SES, gender, race, and ethnicity. A final limitation of the current sample is that only comparing differences in academic performance as they relate to prescription stimulant misuse and ADHD diagnosis leaves a multitude of other possible explanations as to the differences in academic performance.

Next, the abbreviated version of the SSQ retains only 10 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., 2016).

Additionally, 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.

Finally, analyses did not investigate the nature of prescription stimulant misuse among participants with ADHD. While it was clear that individuals in the ADHD group endorsed greater misuse of prescription stimulant medication, it was not clear whether that misuse was predominantly characterized by specific forms of misuse, such as use of one's own prescription stimulant medication in excess of prescribed guidelines compared to acquiring stimulants from other students. Future research should discern which mechanisms of prescription stimulant misuse among individuals with ADHD.

Conclusion

The current study addressed a significant gap in the extant literature by exploring 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 correlate 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) were not significantly related to prescription stimulant misuse. Importantly, prescription stimulant misuse did not moderate the relationship between psychological functioning and GPA. Low motivation and poor test strategies were also associated with 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 be associated with misuse and academic success, specifically, inattention, anxiety, motivation, and test strategies, is needed. In addition, college students should be informed about the lack of empirical evidence to support prescription stimulant misuse as an academic enhancer as well as the potential side effects of prescription stimulant misuse.

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