

Is ADHD, Independent of ODD, Associated With Whether and Why College Students Misuse Stimulant Medication?

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Although previous research suggests that undergraduates with untreated or undertreated attention-deficit/hyperactivity disorder (ADHD) symptoms may have academic motives for stimulant medication misuse, no previous work has examined the relation of ADHD symptoms, controlling for comorbid oppositional defiant disorder (ODD), to misuse, or has explored how these symptoms are differentially related to motives for misuse. Among a sample of 900 students from one public university, the current study first tested whether increased ADHD symptomology (using the Current Symptoms Scale, CSS) was associated with an increased likelihood of misusing stimulant medication, controlling for comorbid ODD. We then examined whether those with increased ADHD symptomology were more likely to report academic motives for misuse. The prevalence rate of misuse in the past year was 22%. Participants who met symptom count criteria for ADHD (controlling for comorbid ODD) were 2.90 times more likely to misuse stimulant medication than those who did not. Among misusers, those who met ADHD criteria were also 2.80 times more likely to report academic motives for misuse. These results support that stimulant medication misuse is likely driven, in part, by inadequate or absent care for the executive functioning impairments associated with ADHD. Therefore, a greater focus on assessment and treatment of college students with ADHD symptoms is warranted.

Public Health Significance

This study suggests that at least some of the risky, illegal stimulant medication misuse by college students is driven by inadequate or absent care for executive functioning impairments. Among an undergraduate sample, increased attention-deficit/hyperactivity disorder (ADHD) symptomology was associated with a higher likelihood of stimulant medication misuse and increased report of academic motivation for misusing stimulant medication.

Keywords: ADHD, college students, stimulant medication misuse

The misuse of prescription stimulant medications (e.g., Adderall, Ritalin) is a growing concern on college campuses. The indicated use of these medications typically reduces attention-deficit/

hyperactivity disorder (ADHD) symptoms that, if left untreated, may impair academic performance (Weyandt et al., 2013). However, the use of stimulant medication in a manner or for purposes other than intended (e.g., to get high) or without a physician's prescription presents potential adverse health outcomes. Given that such risks are assumed by an estimated 17% of college students who misuse stimulant medication, the prevention of such misuse should be a public health priority (Benson, Flory, Humphreys, & Lee, 2015). Previous investigations of stimulant medication misuse have found associations with ADHD symptoms and with academic motives (e.g., Rabiner et al., 2009), and our recent meta-analysis and review found that students most often report academic motives for misuse (Benson et al., 2015). However, these prior studies did not take comorbid oppositional defiant disorder (ODD) symptoms into account when examining the link between ADHD and stimulant medication misuse. This is an important next step as ODD is robustly related to both ADHD and substance use/abuse. Further, prior studies have generally not examined motives for stimulant medication misuse specifically associated with ADHD and ODD symptoms. The current study advances the literature in this area by addressing both of these limitations in our study of ADHD and stimulant medication misuse.

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ADHD Among College Students

Among a nationally representative sample of over 200,000 U.S. first-year students attending college full-time and for the first time, 5.0% of students (3.8% of women and 6.4% of men) reported a previous diagnosis of ADHD (Pryor, Hurtado, DeAngelo, Palucki Blake, & Tran, 2010). A recent study measuring self-reported ADHD symptoms among college students found a slightly higher prevalence of students (approximately 7.5%) currently meeting diagnostic criteria for ADHD (McKee, 2008). Having elevated symptoms of ADHD (e.g., disorganization, distractibility, difficulty following through on instructions) has been associated with academic difficulties in college, including underachievement (Weyandt et al., 2013), poorer study habits and skills, and lower grade point averages (Gormley et al., 2018). Brown and Casey (2016) found increased symptoms of ADHD among college students who do not meet criteria for ADHD (either by self-report or symptom count) to be associated with deficits in executive functioning abilities. Additionally, adults with subthreshold symptoms, 3 to 5 inattentive and/or 3 to 5 hyperactive-impulsive symptoms from the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994), have been shown to experience greater academic impairment than those reporting fewer symptoms and to be less likely to receive treatment than those meeting *DSM-IV* criteria for ADHD (Faraone et al., 2006).

At the same time, more individuals with ADHD are matriculating to college than in the past (DuPaul et al., 2001; Wolf, 2001), and many of these students use prescription stimulant medications to treat their symptoms. McCabe, Teter, and Boyd (2006) reported that 2.2% of college students had prescriptions for stimulant medications annually, whereas Rozenbroek and Rothstein (2011) found that 7.2% of college students reported having prescriptions for stimulant medications since high school. While the prescribed use of stimulant medications may be important for the academic success of students with ADHD, the availability of these medications on college campuses may simultaneously pose a risk for misuse among college students. Not only does stimulant misuse have the potential for abuse similar to other illicit central nervous system stimulants, such as amphetamine and cocaine (Volkow et al., 1995), but it has also been associated with serious short-term risks, such as myocardial infarction (Gandhi, Ezeala, Luyen, Tu, & Tran, 2005). Students with prescription access to stimulant medications may offer their peers an avenue to access these medications, as peers are the most commonly reported source from which college students obtain stimulant medications for misuse (Benson et al., 2015).

There is also evidence that those who have prescriptions may be more likely to misuse than those who do not. A study by Gudmundsdóttir, Weyandt, and Ernudóttir (2016) found that 11% of a sample of Icelandic college students without a prescription for stimulant medication reported misuse, as compared with 42% of those with a prescription. Similarly, among a sample of American undergraduates, a larger proportion of prescription holders (48%) reported stimulant misuse than nonprescription holders (18%; Judson & Langdon, 2009). Due to a lack of research, the reasons for this discrepancy are unclear. Possible explanations include prescription holders having easier access to medications and/or being more likely to exhibit ADHD symptoms.

ADHD, ODD, and Misuse of Stimulant Medication

Increased ADHD symptomology is clearly a risk factor for substance use in general (Gudjonsson, Sigurdsson, Sigfusdóttir, & Young, 2012; Wilens et al., 2011). While there is evidence that ADHD and substance abuse may have some common etiology, such as similar genetic risk factors (Iacono, Malone, & McGue, 2008; Young et al., 2009), there may be a unique relation between ADHD symptoms and stimulant medication misuse. In a longitudinal study of undergraduate students, students at a high-risk for ADHD were more likely to be persistent stimulant misusers than persistent marijuana users or consistent nonusers of drugs (17.0% v. 9.2% v. 8.2%, respectively; Arria et al., 2011). A survey of college students found that 71% of stimulant medication misusers screened positive for ADHD symptoms (Peterkin, Crone, Sheridan, & Wise, 2011), and attention problems have been shown to increase the odds of becoming a misuser by 1.78 times (Rabiner, Anastopoulos, Costello, Hoyle, & Swartzwelder, 2010). Another study found a 27% prevalence rate of ADHD among stimulant misusers as opposed to 16% of those who did not report stimulant misuse (Wilens et al., 2016).

ADHD often co-occurs with ODD, which is characterized by a persistent pattern of defiance, anger, irritability, vindictiveness, and/or disobedience of adults or other authority figures. Recently, a nationally representative sample of adult participants ($N = 3,199$) reported a lifetime ODD prevalence of 10.2% (Nock, Kazdin, Hiripi, & Kessler, 2007). Elia, Ambrosini, and Berrettini (2008) found that 138 out of 340 (41%) youth aged 6–18 diagnosed with ADHD also met diagnostic criteria for ODD. A 2015 study of youth in two communities in the United States by Cuffe et al. (2015) found that 139 of 259 (54%) youth meeting parent-report criteria for ADHD also met parent-report criteria for ODD. It is not surprising that ADHD and ODD would overlap so strongly, given that much of their symptomology has been shown to relate strongly to what Burns, de Moura, Beauchaine, and McBurnett (2014) called a “general disruptive behavior factor.” ODD is also robustly associated with substance use and abuse, including alcohol and illicit drug use (Fergusson, Boden, & Horwood, 2008; Swendsen et al., 2010). For example, in the aforementioned nationally representative survey by Nock et al. (2007), 47.2% of those who reported meeting criteria for ODD in their lifetime also reported meeting criteria for a *DSM-IV* (American Psychiatric Association, 1994) substance use disorder for alcohol or illicit drugs. ODD has been posited as a developmental antecedent of substance abuse, with traits associated with ODD, such as noncompliance and temper in adolescence, significantly associated with illicit drug use in young adulthood (Brook, Whiteman, Finch, & Cohen, 1996).

Despite these strong documented associations among ADHD, ODD, and substance use/abuse, existing research on the link between ADHD and stimulant medication misuse has not controlled for comorbid ODD. In addition, there is little extant research on ODD and rates of stimulant medication misuse or the motivations for such misuse among college students. As such, it is unclear how motives associated with ODD may differ from those associated with ADHD. The current study addresses these limitations while adding to the literature on ADHD and stimulant medication misuse.

Motivations for Misuse of Stimulant Medication

Stimulant medications are sometimes misused among college students for recreational purposes—that is, students use stimulants in order to “get high” or to prolong the effects of other substances, such as alcohol (Gudjonsson et al., 2012). The latter scenario is especially dangerous, as it’s been shown to increase the likelihood of adverse outcomes related to heavy alcohol use, such as driving while intoxicated, blacking out, missing class or work due to drinking, or having unplanned sexual intercourse (McCabe, Cranford, Morales, & Young, 2006). However, there are a range of other, functional reasons for stimulant medication misuse among college students; in particular, students often misuse stimulants for academic purposes. Multiple studies have indicated that the most common reasons for misuse are related to academics. For example, “to concentrate better while studying” (Rabiner et al., 2009), “to improve study skills” (Peterkin et al., 2011), “to stay awake to study longer” (DeSantis, Webb, & Noar, 2008), and “to improve concentration” (Judson & Langdon, 2009) were the most commonly endorsed motives in several existing studies. Consistent with these findings, a survey of undergraduates showed that very few students misuse for only nonacademic reasons: 54% misused only for academic reasons, 6% misused only for nonacademic reasons, and 40% misused for both purposes (Rabiner et al., 2009).

Rabiner and colleagues (2009) demonstrated that those who misuse for academic reasons report more difficulties with attention and greater academic concerns than those who misuse exclusively for nonacademic purposes, suggesting that there may be a relation between ADHD symptoms and academic motives for misuse. A review by Lakhan and Kirchgessner (2012) found consistent support in the literature for stimulant medication improving some aspects of executive functioning, such as vigilance, among those with ADHD. For example, Schweitzer et al. (2004) found that adult males taking stimulant medication showed improvements in a task involving working memory, attention, response inhibition, and processing speed. Students may be misusing stimulant medications as a way to improve attentional problems, even if they were never professionally diagnosed with ADHD. This suggests a rather different image of stimulant misuse than the prototypical image of college students misusing for recreational reasons; namely, college students with symptoms of ADHD may be misusing for a functional purpose to self-treat attention and academic difficulties.

Currently, there are not any known empirically supported prevention programs that target the misuse of stimulant medication on college campuses. One prevention approach, targeted to at-risk undergraduates and focused on challenging positive consequence-oriented beliefs about stimulant medications, failed to show reductions in rates of misuse compared with controls at 6-month follow-up (Looby, De Young, & Earleywine, 2013). In order to develop effective prevention programs, we must improve our understanding of why students misuse prescription stimulants. If stimulant medication misuse is related to recreational factors, prevention should be incorporated into existing drug and alcohol programs on campuses. On the other hand, if students are attempting to self-treat symptoms of ADHD, that implies that improving the detection and treatment of ADHD symptoms among college students could be a promising way to reduce misuse.

The Current Study

Using an online survey administered to a large sample of college students, the current study sought to add to the literature on ADHD and stimulant medication misuse. We tested two hypotheses. The first, based on previous literature, was that students with increased ADHD symptomology would be more likely to misuse stimulant medication. We tested increased symptoms of ADHD, as well as meeting symptom count criteria for a diagnosis of ADHD, because subthreshold ADHD can still cause significant impairment (Judson & Langdon, 2009) and increases the likelihood of adverse educational outcomes (Hong et al., 2014). Importantly, we addressed a limitation of previous literature by hypothesizing that the relation between ADHD and stimulant medication misuse would still hold while accounting for comorbid symptoms of ODD, which are robustly related to both ADHD symptoms and substance misuse.

Our second hypothesis was that students with increased ADHD symptomology and those meeting symptom count criteria for a diagnosis of ADHD (controlling for ODD symptoms) would be more likely to misuse for academic reasons, but not recreational reasons. If these students are in fact attempting to self-treat symptoms of ADHD, their motivations for misuse should be related to academics, for example “to concentrate better while studying” or “to feel less restless during class,” as opposed to “to get high.”

Method

Participants and Procedure

Participants were undergraduate students age 18 or older at a large, public university in the southeastern United States. The study was advertised on class Facebook pages (e.g., Class of 2015). It was also offered on the psychology participant pool website, which allows students enrolled in psychology classes to earn extra credit for participation in research studies. Professors of large classes (80+ students) outside of psychology were also contacted to see if they would allow us to speak to their class about participating in the study. Further, different schools within the university (e.g., the School of Business) were contacted to ask if they would share the survey link with their students.

A total of 936 students completed the online survey ($N = 936$). We did not ask participants to give their name or other identifying data. As a validity check, we included the same question about alcohol use twice in the survey (the survey also assessed behaviors not included in the current study), spaced 17 questions apart. The question asked, “In the past 12 months, how often did you drink beer, wine, wine coolers, or liquor?” Possible responses were *not at all*, *1–3 times*, *4–7 times*, *8–11 times*, *once a month*, *2–3 times a month*, *once a week*, *2–3 times a week*, *4–6 times a week*, *once a day*, *twice a day*, and *several times a day*, with each assigned a number in order from 1–12. Participants were removed from the sample if their responses on the two identical questions were more than two answers apart. For example, an invalid response would be *2–3 times a month* for the first question and *4–6 times a week* for the second. Thirty-six participants ($N = 36$) were removed from the data set for such invalid responses.

The statistical sample (referred to hereafter as the sample, $N = 900$) was predominantly female (76%) and Caucasian (80%).

There was a relatively even spread across the classes; 29% of participants were first year students, 28% were second year, 24% were third year, 17% were fourth year, and 3% were fifth year or beyond. Twenty-seven percent were fraternity or sorority members. Women and fraternity/sorority members were overrepresented compared with the broader university population (54% and 21% respectively), though the proportion of non-Caucasian students in the sample was similar to the university population. The median annual family income for the sample was between \$100,000 and \$149,999.

An online survey was administered to participants through Qualtrics (<https://www.qualtrics.com/>) for a 2-month period of time (March–April) during the Spring semester of 2014. In order to participate, students had to indicate that they were at least 18 years old and an undergraduate student at the university and consent to study participation. Students took 15–60 min to complete the survey with the majority completing the survey in 30–45 min. They received course credit (if relevant) for participating in the study and were entered into a drawing to win one of three \$75 Target gift cards. The university institutional review board approved the study protocol.

Measures

Demographics. Participants reported their age, gender, race, family household income, year in college, cumulative college GPA, and if they were a member of a Greek organization (i.e., social sorority or fraternity).

ADHD and ODD symptoms. The Current Symptoms Scale (CSS; Barkley & Murphy, 2006) was used to assess for current ADHD symptoms. This instrument includes 18 items (e.g., “Lose things necessary for tasks or activities”) describing behavioral manifestations of ADHD symptom dimensions of inattention and hyperactivity/impulsivity as defined in the *DSM-IV-TR* (American Psychiatric Association, 2000). Participants rated the frequency with which they had experienced each behavior in the previous 6 months on a 4-point scale ranging from *never or rarely* to *always*. Behaviors rated as having occurred *often* or *always* were considered a current symptom endorsement (Barkley & Murphy, 2006). In the present study, the endorsement of six or more symptoms from either symptom dimension indicated that the rater met symptom count diagnostic criteria for ADHD (*DSM-IV-TR*; American Psychiatric Association, 2000). The CSS demonstrated strong reliability among our sample for current inattentive symptoms ($\alpha = .87$), current hyperactive/impulsive symptoms ($\alpha = .81$), and overall ($\alpha = .91$).

We also used the CSS (Barkley & Murphy, 2006) to assess for current ODD symptoms. To assess for current symptoms of ODD, the CSS includes 8 items describing behavioral manifestations of ODD (e.g., “Blame others for my mistakes or misbehavior”), as defined in the *DSM-IV-TR* (American Psychiatric Association, 2000). Participants rated the frequency with which they had experienced each behavior in the previous 6 months on a 4-point scale ranging from *never or rarely* to *always*. Behaviors rated as having occurred *often* or *always* were considered a current symptom endorsement (Barkley & Murphy, 2006). In the present study, the endorsement of four or more symptoms indicated the rater met symptom count diagnostic criteria for ODD (*DSM-IV-TR*; Amer-

ican Psychiatric Association, 2000). The current ODD scale of the CSS demonstrated strong reliability in our sample ($\alpha = .81$).

Stimulant medication misuse. Survey items used to assess stimulant medication misuse were adapted from items utilized in past studies (Rabiner et al., 2009; Sepúlveda et al., 2011) and with input from a focus group of eight undergraduate students that was drawn from the same institution as the analytic sample in the present study. Participants endorsing a current prescription for stimulant medications generally used to treat ADHD were asked to indicate which of the following behaviors they had engaged in during the previous 12 months, if any: they had used too much medication, used the medication more often than prescribed, snorted the medication, mixed the medication with other drugs, used stimulant medication that they did not have a prescription for, or none of these. If they indicated any of these behaviors, they were asked how often, with responses ranging from *1–3 times* to *several times a day*.

Students who indicated they did not have a prescription for stimulant medication were asked, “In the past 12 months, what behaviors did you engage in related to stimulant medication?” Participants chose from a list of the following behaviors and could indicate multiple behaviors: they used stimulants that they did not have a prescription for, snorted medication, mixed medication with other drugs, or none of these. If they indicated any of these, they were asked how often using the same scale as prescription misusers. Endorsement of at least one of the previously described behaviors in the past year was considered an endorsement of past year stimulant misuse.

Motivation for stimulant medication misuse. Motives for stimulant medication misuse were assessed by survey items adapted from previous research (DeSantis et al., 2008; Judson & Langdon, 2009; Rabiner et al., 2009) and with input from a focus group of eight undergraduate students at the university. Participants who indicated they misused stimulant medication in any form were asked, “How often have you used stimulant medication that you did not have a prescription for or used more than prescribed for the following reasons in the last year?” The motives listed are shown in full in Table 1. For each of these motives, participants could respond, *never*, *rarely*, *sometimes*, *often*, or *always*. Indicating *often* or *always* for a given motive was considered endorsing that motive for our analyses. Participants were able to endorse multiple motives for misuse.

We created composite dichotomous variables for academic and recreational motives. If participants reported misuse for at least one motive in a given category (academic or recreational), they were considered to have endorsed that category of motives. Recreational motives included to get high, to prolong the intoxicating effects of alcohol, and to feel better; academic motives included to concentrate while studying, to study longer, to be less restless while studying, to concentrate in class, to be less restless in class, to keep better track of assignments, and to keep other students from having an academic edge over them. We chose to create dichotomous variables for academic and recreational motives from the endorsement of one or more of those motives because our aim was to differentiate between those who had engaged in misuse for academic and recreational motives, respectively, and those who had not.

Table 1
Frequency of Motives for Misuse (n = 201)

Motives	Number endorsing	% of misusers
Academic (at least one)	125	62
To concentrate better while studying	121	61
To be able to study longer	121	61
To feel less restless while studying	90	45
To concentrate better in class	46	23
To feel less restless in class	33	16
To keep better track of assignments	42	21
To prevent other students from having an academic edge over me	17	8
Recreational (at least one)	20	10
To feel better	10	5
To get high	3	2
To prolong the intoxicating effects of alcohol or other substances	8	4
Other (at least one)	89	44
To complete other tasks not related to school	29	14
To stay awake longer	83	41
To improve athletic performance	1	1
To lose weight	9	4

Data Analysis

We used logistic regression to examine the relation between ADHD symptoms and misuse of prescription stimulant medication among our sample ($N = 900$), using pairwise deletion for missing data. There was very little missing data, with 5% or less missing data per question. Misuse was analyzed as a dichotomous outcome variable representing whether a student had misused a prescription stimulant medication in the past year (1 = yes).

We tested whether meeting symptom count diagnostic criteria for ADHD increased the odds of stimulant misuse. Gender, ethnicity, year in school, prescription status, membership in a fraternity or sorority, cumulative college GPA, and meeting symptom count diagnostic criteria for ODD were included as covariates. ODD was covaried because of its overlap with both ADHD and substance use/abuse, and because examining the association between ADHD and misuse controlling for ODD was one of our main study aims. The other covariates were selected because our recent comprehensive review and meta-analysis of the literature on misuse among college students found them to be related to stimulant medication misuse (Benson et al., 2015). A separate model was also tested that used ADHD symptom count rather than the dichotomous ADHD diagnosis variable (based on meeting symptom count threshold) to test whether increased ADHD symptomatology increased the odds of stimulant misuse.

In order to test for differences in motives related to ADHD, we conducted logistic regressions for misusing for academic motives and recreational motives among those reporting past-year misuse ($n = 201$). While the conventional logistic model was used for academic motives, only 20 participants in our study endorsed recreational motives for stimulant misuse. King and Zeng (2001) demonstrated that the maximum likelihood estimation used by the conventional logistic model could be biased when the rarer of the two outcomes has a small number of cases. Therefore, exact logistic regression was used for the model predicting recreational motives for stimulant misuse in order to avoid this potential bias in estimation (Mehta & Patel, 1995). We tested separate, identical models measuring whether meeting symptom count diagnostic criteria for ADHD was associated with increased odds of endorsing

each category of motive for misuse. Gender, ethnicity, prescription status, membership in a fraternity or sorority, year in school, cumulative college GPA, and meeting symptom count diagnostic criteria for ODD were again included as covariates. We also tested each model using ADHD symptom count rather than the dichotomous ADHD diagnosis variable in order to test whether increased ADHD symptom endorsement was associated with increased odds of endorsing each category of motives. We conducted all analyses using SAS 9.4 (SAS Institute Inc., Cary, NC).

Results

Rates of ADHD and ODD

Overall, participants reported an average of 3.43 current total symptoms of ADHD ($SD = 4.32$). A total of 120 (13%) participants met symptom count criteria for a diagnosis of ADHD based on report of current symptoms on the CSS. Participants reported an average of 0.94 symptoms of ODD ($SD = 1.64$) and 79 (9%) met symptom count criteria for a diagnosis of ODD based on report of current symptoms. Notably, 38 of the 120 (32%) participants who met symptom count criteria for ADHD also met symptom count criteria for ODD. A detailed breakdown of participants meeting symptom count criteria is shown in Table 2. Among the 120 participants meeting symptom count criteria for ADHD, 37 (31%) reported having a prescription for stimulant medication, while 59 of the 780 (8%) participants not meeting symptom count criteria reported having a stimulant medication prescription.

Table 2
Participants Meeting Symptom Count Criteria for ADHD and ODD

Variable	Did not meet criteria for ADHD	Met criteria for ADHD	Total
Did not meet criteria for ODD	739	82	821
Met criteria for ODD	41	38	79
Total	780	120	900

Prescription Status and Frequency of Misuse

Overall, 22% ($n = 201$) of the sample reported misuse of stimulant medications in the past year. A total of 101 participants (11% of the sample) reported holding a current prescription for stimulant medication. Of those who indicated what stimulant medication they had a prescription for, 57% used Adderall, 27% used Vyvanse, 8% used Ritalin, 6% used Concerta, 3% used Focalin, 2% used Nuvigil, and 1% used Provigil. Six percent of prescription holders indicated that they had prescriptions for two stimulant medications. Thirty-four percent ($n = 34$) of these prescription holders indicated misusing medication in the past year. Among the 770 participants (86% of the sample) who reported that they did not have a current prescription for stimulant medication, 165 (22%) reported misuse of stimulant medication in the past year. Twenty-nine participants (3%) did not indicate whether they had a current prescription for stimulant medication. Because pairwise deletion was used, these 29 participants were not included in the regression analyses. Summaries of reported misuse by prescription status are provided in Tables 3 and 4.

Misuse and Symptoms of ADHD

Our first hypothesis stated that increased symptoms of ADHD and meeting symptom count diagnostic criteria for ADHD would be associated with increased likelihood of stimulant misuse, even after controlling for ODD. Among the 120 students who met CSS symptom-count criteria for ADHD, 51 (43%) reported stimulant misuse, compared with 139 (18%) of those who did not meet criteria for ADHD. Results are presented in Table 5. Consistent with our hypothesis, participants who met the symptom count criteria for ADHD diagnosis were 2.90 times more likely to misuse stimulant medication than those who did not, even after controlling for ODD. Meeting the symptom count criteria for ODD was not significantly associated with being more likely to misuse. Among our covariates, being male (odds ratio, $OR = 1.59$), being white (vs. nonwhite; $OR = 1.67$), being a member of a fraternity or sorority ($OR = 1.87$), and being in the third year ($OR = 1.91$) or

Table 4

Behaviors Endorsed by Misusers Without a Stimulant Medication Prescription ($n = 165$)

Type of misuse	Frequency
Took stimulant medication that I do not have a prescription for	100% ($n = 165$)
Snorted stimulant medication	18% ($n = 30$)
Took stimulant medication with other drugs	18% ($n = 30$)
Alcohol	16% ($n = 27$)
Marijuana	13% ($n = 21$)
LSD or mushrooms	1% ($n = 1$)
Ecstasy, MDMA, or Molly	1% ($n = 1$)
Cocaine	2% ($n = 3$)
Heroin	0% ($n = 0$)
Methamphetamine	0% ($n = 0$)
Sedatives, barbiturates, or tranquilizers	1% ($n = 1$)
Narcotics	1% ($n = 2$)
Steroids	0% ($n = 0$)
Other	0% ($n = 0$)

fourth year or more ($OR = 1.82$) of school were associated with increased likelihood of misuse. Higher GPA was associated with a significant decrease in likelihood of misuse ($OR = 0.60$).

When measured as a total symptom count for ADHD (rather than a diagnosis), results showed that each additional symptom of ADHD endorsed increased the odds of misusing by 1.12 (see Table 6). Again, meeting symptom count criteria for ODD was not associated with an increased likelihood of misuse. Importantly, in both analyses, ADHD remained significantly related to stimulant medication misuse even after controlling for the overlap among ADHD and ODD as well as a number of additional covariates shown in prior research to be robust predictors of misuse (e.g., gender, membership in a sorority or fraternity). Aside from being white (vs. nonwhite), which was not significant in this model, covariates significant in the previous model (i.e., GPA, being male, fraternity/sorority membership, being in third and fourth or more year of school) were also significant in this model.

Symptoms of ADHD and Academic Motives for Misuse

We next sought to understand if the motivations for misuse among students with increased ADHD symptoms were different than the motivations for students with fewer symptoms. See Table 1 for the frequency of endorsement of all motives. Overall, academic motives were more frequently endorsed than nonacademic motives. The most frequently endorsed motives of misuse were to concentrate while studying ($n = 121$, 61% of misusers) and to study longer ($n = 121$, 61%); only three participants indicated using to get high (2%), and only one indicated using to improve athletic performance (1%).

Our second hypothesis stated that we expected meeting diagnostic criteria for ADHD and having more symptoms of ADHD would be significantly associated with academic motives but not recreational motives among those reporting misuse. Importantly, we controlled for meeting ODD symptom count criteria while testing these associations. Consistent with this hypothesis, participants who met criteria for ADHD diagnosis (based on current symptom count from the CSS) were 2.80 times more likely to

Table 3

Behaviors Endorsed by Misusers With a Stimulant Medication Prescription ($n = 34$)

Type of misuse	Frequency
Took too much of my medication (a greater dosage)	68% ($n = 23$)
Took medication more often than prescribed	47% ($n = 16$)
Snorted stimulant medication	32% ($n = 11$)
Took stimulant medication that I do not have a prescription for	21% ($n = 7$)
Took stimulant medication with other drugs	44% ($n = 15$)
Alcohol	44% ($n = 15$)
Marijuana	38% ($n = 13$)
LSD or mushrooms	0% ($n = 0$)
Ecstasy, MDMA, or Molly	3% ($n = 1$)
Cocaine	15% ($n = 5$)
Heroin	0% ($n = 0$)
Methamphetamine	0% ($n = 0$)
Sedatives, barbiturates, or tranquilizers	12% ($n = 4$)
Narcotics	6% ($n = 2$)
Steroids	0% ($n = 0$)
Other (Ketamine)	3% ($n = 1$)

Table 5
Binary Logistic Regression With Odds Ratio of Being a Misuser (Meeting ADHD Symptom Count Criteria) ($N = 900$)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	Meets criteria	13% ($n = 120$)	2.90*	[1.78, 4.73]	<.001
	Does not meet criteria	83% ($n = 745$)	1.00		
Gender	Male	24% ($n = 217$)	1.59*	[1.07, 2.37]	.023
	Female	76% ($n = 681$)	1.00		
Race	White	80% ($n = 723$)	1.67*	[1.02, 2.76]	.044
	Non-White	20% ($n = 177$)	1.00		
Prescription status	Prescription	11% ($n = 101$)	1.10	[.65, 1.87]	.717
	No prescription	86% ($n = 770$)	1.00		
Fraternity/sorority membership	Yes	27% ($n = 241$)	1.87*	[1.26, 2.76]	.002
	No	73% ($n = 659$)	1.00		
GPA	(Incremental OR)	—	.60*	[.40, .88]	.009
ODD symptom count	Meets criteria	9% ($n = 79$)	1.18	[.66, 2.12]	.568
	Does not meet criteria	85% ($n = 765$)	1.00		
Year in school	First	28% ($n = 256$)	1.00		
	Second	28% ($n = 251$)	1.08	[.66, 1.77]	.763
	Third	22% ($n = 210$)	1.91*	[1.17, 3.11]	.010
	Fourth or more	20% ($n = 178$)	1.82*	[1.09, 3.05]	.023

* $p < .05$.

report academic motives for misuse compared with those who did not (see Table 7). When measured as a total symptom count for ADHD (rather than a diagnosis), results showed that participants were 1.11 times more likely to report academic motives for each additional symptom of ADHD endorsed (see Table 8). Also consistent with our hypothesis, neither meeting criteria for ADHD nor endorsing additional symptoms of ADHD were associated with reporting recreational motives for misuse. In the model including ADHD diagnosis, participants who met criteria for the ODD diagnosis (based on symptom count from the CSS) were 3.42 times more likely to report recreational motives for misuse compared with those who did not (see Table 9). Similar results were found when ADHD symptom count was used, with students meeting criteria for ODD being 3.37 times more likely to report recre-

ational motives for misuse (see Table 10). None of the covariates were significant in the models examining motives.

Discussion

Results from the current study add to the literature on ADHD and stimulant medication misuse by addressing several important limitations of previous studies. First, consistent with other studies (e.g., Rabiner et al., 2009), we found stimulant medication misuse to be significantly related to increased current ADHD symptoms and diagnosis of ADHD (based on symptom count), indicating that those experiencing higher levels of ADHD symptomology are more likely to misuse stimulant medication. However, our study provided a more stringent test of this link in that we found that

Table 6
Binary Logistic Regression With Odds Ratio of Being a Misuser (ADHD Symptom Count; $N = 900$)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	(Incremental OR)	—	1.12*	[1.07, 1.17]	<.001
Gender	Male	24% ($n = 217$)	1.62*	[1.08, 2.42]	.017
	Female	76% ($n = 681$)	1.00		
Race	White	80% ($n = 723$)	1.65	[1.00, 2.73]	.113
	Non-White	20% ($n = 177$)	1.00		
Prescription status	Prescription	11% ($n = 101$)	.94	[.55, 1.61]	.931
	No prescription	86% ($n = 770$)	1.00		
Fraternity/sorority membership	Yes	27% ($n = 241$)	1.83*	[1.23, 2.71]	.004
	No	73% ($n = 659$)	1.00		
GPA	(Incremental OR)	—	.60*	[.41, .89]	.011
ODD symptom count	Meets criteria	9% ($n = 79$)	1.01	[.56, 1.81]	.813
	Does not meet Criteria	85% ($n = 765$)	1.00		
Year in school	First	28% ($n = 256$)	1.00		
	Second	28% ($n = 251$)	1.09	[.67, 1.80]	.677
	Third	22% ($n = 210$)	1.98*	[1.21, 3.25]	.009
	Fourth or more	20% ($n = 178$)	1.90*	[1.13, 3.20]	.013

* $p < .05$.

Table 7
Binary Logistic Regression With Odds Ratio of Academic Misuse (Meeting ADHD Symptom Count Criteria; $n = 201$)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	Meets criteria	25% ($n = 51$)	2.80*	[1.21, 6.52]	.017
Race	White	85% ($n = 171$)	1.16	[.47, 2.86]	.741
	Non-White	15% ($n = 30$)	1.00		
Prescription status	Prescription	18% ($n = 36$)	.58	[.22, 1.52]	.265
	No prescription	82% ($n = 165$)	1.00		
Fraternity/sorority membership	Yes	36% ($n = 73$)	.67	[.34, 1.31]	.240
	No	64% ($n = 128$)	1.00		
GPA	(Incremental OR)	—	.56	[.25, 1.21]	.138
ODD symptom count	Meets criteria	14% ($n = 28$)	.92	[.34, 2.50]	.868
	Does not meet criteria	83% ($n = 167$)	1.00		
Year in school	First	21% ($n = 43$)	1.00		
	Second	26% ($n = 53$)	.83	[.33, 2.10]	.688
	Third	29% ($n = 59$)	.85	[.34, 2.10]	.720
	Fourth or more	23% ($n = 46$)	.74	[.29, 2.50]	.540

* $p < .05$.

these results remained significant after controlling for ODD symptoms, a disorder that frequently co-occurs with ADHD and is strongly related to substance use (Fergusson et al., 2008; Swendsen et al., 2010). It is very important to control for comorbid ODD when examining the association between ADHD and misuse of stimulant medications, as ODD could explain the significant link demonstrated in prior studies. To our knowledge, our study is the first in this area of research to take into account comorbid ODD symptoms.

The current study also found that ADHD symptoms were uniquely related to academic motives for stimulant medication misuse. Consistent with prior studies (e.g., Rabiner et al., 2009) and our previous review and meta-analysis (Benson et al., 2015), we found academic motives to be the primary motivation for misuse among students with significant ADHD symptoms. Therefore, these findings suggest that much of the stimulant misuse on college campuses may be, at least in the perception of misusers,

attempts to manage inadequately treated or untreated deficiencies in executive functioning. Stimulant medications have been found to reliably improve some of these functions, for example, on a task testing working memory, attention, response inhibition, and processing speed (Schweitzer et al., 2004). The current study also found that ODD symptoms were related to recreational motives for misuse, while ADHD symptoms were not. However, it is noted that only 20 of the 201 students who reported misuse endorsed recreational motives, resulting in large confidence intervals for these odds ratios and limiting the generalizability of this particular finding.

Though not central to our research questions, our findings related to the demographics of students reporting stimulant medication misuse were consistent with a recent review of the literature (Benson et al., 2015). We found that males and fraternity/sorority members were significantly more likely to misuse. Past research has been mixed for the relations of race and year in school

Table 8
Binary Logistic Regression With Odds Ratio of Academic Misuse (ADHD Symptom Count; $n = 201$)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	(Incremental OR)	—	1.11*	[1.03, 1.20]	.010
Gender	Male	29% ($n = 59$)	1.39	[.67, 2.89]	.381
	Female	71% ($n = 142$)	1.00		
Race	White	85% ($n = 171$)	1.21	[.49, 2.98]	.678
	Non-White	15% ($n = 30$)	1.00		
Prescription status	Prescription	18% ($n = 36$)	.54	[.20, 1.43]	.214
	No prescription	82% ($n = 165$)	1.00		
Fraternity/sorority membership	Yes	36% ($n = 73$)	.64	[.33, 1.27]	.202
	No	64% ($n = 128$)	1.00		
GPA	(Incremental OR)	—	.54	[.25, 1.17]	.119
ODD symptom count	Meets criteria	14% ($n = 28$)	.82	[.30, 2.27]	.703
	Does not meet criteria	83% ($n = 167$)	1.00		
Year in school	First	21% ($n = 43$)	1.00		
	Second	26% ($n = 53$)	.86	[.34, 2.20]	.750
	Third	29% ($n = 59$)	.82	[.33, 2.06]	.679
	Fourth or more	23% ($n = 46$)	.75	[.29, 1.97]	.564

* $p < .05$.

Table 9

Binary Logistic Regression With Odds Ratio of Recreational Misuse (Meeting ADHD Symptom Count Criteria; n = 201)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	Meets criteria	25% (n = 51)	1.48	[.47, 4.62]	.504
	Does not meet criteria	70% (n = 139)	1.00		
Gender	Male	29% (n = 59)	.97	[.31, 3.04]	.963
	Female	71% (n = 142)	1.00		
Race	White	85% (n = 171)	.28	[.08, 1.02]	.054
	Non-White	15% (n = 30)	1.00		
Prescription status	Prescription	18% (n = 36)	2.18	[.61, 7.75]	.229
	No prescription	82% (n = 165)	1.00		
Fraternity/sorority membership	Yes	36% (n = 73)	1.82	[.61, 5.44]	.287
	No	64% (n = 128)	1.00		
GPA	(Incremental OR)	—	.86	[.27, 2.70]	.792
ODD symptom count	Meets criteria	14% (n = 28)	3.42*	[1.07, 10.90]	.038
	Does not meet criteria	83% (n = 167)	1.00		
Year in school	First	21% (n = 43)	1.00		
	Second	26% (n = 53)	.65	[.16, 2.58]	.535
	Third	29% (n = 59)	.77	[.21, 2.78]	.692
	Fourth or more	23% (n = 46)	.33	[.06, 1.91]	.218

* $p < .05$.

with stimulant misuse, with Caucasians and upperclassmen misusing more often in some studies (Benson et al., 2015). Our study found no significant relation between race and misuse, but being in the third or higher year of school was associated with significantly increased odds of misusing. Benson et al. (2015) found mixed evidence among three prior studies examining the relation between GPA and stimulant misuse. McCabe, Teter, et al. (2006) and Rabiner et al. (2009) found misuse to be significantly associated with lower GPA, while Advokat, Guidry, and Martino (2008) found no difference in GPA between nonusers and misusers. Consistent with the former studies, the present study showed a higher GPA to be associated with lower odds of stimulant misuse.

Of particular importance to prevention and intervention scientists, our results also bolster past research indicating that stimulant medication is widely available to those without prescriptions (De-

Santis et al., 2008) on college campuses. Prescription status did not significantly predict misuse among our sample. Given that only 31% of those meeting symptom count criteria for ADHD reported having a prescription for stimulant medication, prescription status does not appear to be a determining factor in whether or not a student misused stimulant medication. It seems likely, therefore, that the simple discrepancy found in prevalence of misuse between prescription holders and nonprescription holders may be attributable to other factors, such as the higher prevalence of ADHD among those with a prescription as compared with those without one. Further, 69% of misusers without a prescription reported using four or more times in the last year, with 18% using 2–3 times a month or more. This suggests that many students who misuse stimulant medications do so repeatedly; misuse does not appear to be a behavior that occurs only once or twice in a student's

Table 10

Binary Logistic Regression With Odds Ratio of Recreational Misuse (ADHD Symptom Count; n = 201)

Variables	Group	Frequency	OR	95% CI	p
ADHD symptom count	(Incremental OR)	—	1.03	[.92, 1.16]	.578
Gender	Male	29% (n = 59)	.99	[.31, 3.10]	.982
	Female	71% (n = 142)	1.00		
Race	White	85% (n = 171)	.28	[.08, 1.03]	.055
	Non-White	15% (n = 30)	1.00		
Prescription status	Prescription	18% (n = 36)	2.22	[.63, 7.83]	.216
	No prescription	82% (n = 165)	1.00		
Fraternity/sorority membership	Yes	36% (n = 73)	1.78	[.60, 5.33]	.301
	No	64% (n = 128)	1.00		
GPA	(Incremental OR)	—	.87	[.27, 2.74]	.805
ODD symptom count	Meets criteria	14% (n = 28)	3.37*	[1.03, 11.10]	.046
	Does not meet criteria	83% (n = 167)	1.00		
Year in school	First	21% (n = 43)	1.00		
	Second	26% (n = 53)	.65	[.16, 2.59]	.541
	Third	29% (n = 59)	.75	[.21, 2.69]	.657
	Fourth or more	23% (n = 46)	.33	[.06, 1.88]	.211

* $p < .05$.

academic career. Because students are demonstrating this pattern of misuse over time, it is critical that universities and colleges develop prevention and intervention programs to reduce the occurrences of misuse. One previous prevention effort that attempted to challenge at-risk undergraduate's positive expectancies about misusing stimulant medication failed to reduce misuse, but showed some promise by significantly modifying expectancies for such misuse (Looby et al., 2013). Future efforts could build on these prior efforts, using the results of the present study and other more recent research to improve the targeting and delivery of prevention programs.

Our results have significant implications for college administrators and clinicians. First, there is a large portion of the student population that is indicating untreated or inadequately treated symptoms of ADHD and executive functioning deficits. Thirteen percent of our sample met *DSM-IV* (American Psychiatric Association, 1994) symptom-count criteria for ADHD. Though they may not meet the full diagnostic criteria for ADHD, it is possible that some of these students find their symptoms impairing enough that they turn to illicit use of stimulant medication. There is a critical need for treatment and support of students with attention and academic difficulties on college campuses, as well as improved methods of identifying students who could benefit from these supports. Supports could include assistance with organization, time management, and study skills, using an approach such as cognitive behavioral therapy (e.g., Weiss et al., 2012), as well as prescribing stimulant medications to students who do meet full ADHD diagnostic criteria. Because ADHD symptoms were related to stimulant medication misuse, a focus on the reduction of symptoms of and impairments associated with ADHD in the college population could decrease the misuse of stimulant medication on college campuses. Also, ODD was related to misusing for recreational reasons, so appropriate identification and treatment of this disorder may also reduce misuse.

Limitations

There are several limitations to our study that are important to acknowledge. First, we recruited our sample from a single public university in the southeastern United States, and these students reported a relatively high median family income. Therefore, our results may not be generalizable to all undergraduate students. Additionally, our sample contained more females and fraternity/sorority members than the university population from which it was drawn. Many students completed the survey through the psychology participant pool for extra credit in psychology courses and there are more female than male psychology majors. Our results demonstrated that females are less likely to misuse, while fraternity/sorority members are more likely to misuse. As a result, our overall prevalence rate of misuse may have been underestimated or overestimated.

Second, because our study was cross-sectional, the inferences that can be drawn from some of the findings are limited. Symptoms of ADHD were associated with significantly increased odds of misusing, but causality cannot be determined from our data. Students could be attempting to self-treat preexisting symptoms of ADHD, but such temporality could not be established with the design of the present study. It is noted, however, that the *DSM-5* (American Psychiatric Association, 2013) criteria for ADHD stip-

ulate that several ADHD symptoms must be present before the age of 12. Therefore, from a developmental standpoint, ADHD as an antecedent of misuse appears likely. It is also possible that there could be a third variable driving these relations, such as depression symptoms or academic achievement. We recently tested relations among depression, ADHD, and misuse in the same sample, finding that the link between depression and stimulant misuse was not significant once symptoms of ADHD were included in the analysis (Benson & Flory, 2017). To our knowledge, the relations among academic achievement, ADHD, and stimulant misuse have not been explicitly studied. Increased ADHD symptomology has been consistently associated with worse academic outcomes in college (e.g., Gormley et al., 2018; Weyandt et al., 2013), and in our recent meta-analysis, six of the eight reviewed studies on academic outcomes and stimulant misuse found significantly worse outcomes for misusers versus nonusers (Benson et al., 2015). Longitudinal studies are needed to better understand the directional nature of the relation between ADHD and stimulant medication misuse, as well as any significant moderators or mediators of this relation.

Finally, there are some limitations related to measurement. Because our measurement of the symptoms of ADHD and ODD was subject to self-report bias, they may not be as accurate as an assessment that also includes parent or other-report. There is also a possibility that some participants replied to questions related to stimulant misuse in a socially desirable manner, but we attempted to minimize this potential by collecting our data online and not asking participants for names or other identifiers. Also, as mentioned, *DSM-5* (American Psychiatric Association, 2013) criteria require the presence of symptoms before the age of 12, as well as the occurrence of symptoms in multiple settings. Therefore, proper diagnosis of ADHD would also require evaluation of symptoms across settings and before the age of 12. Also, our measure of motives for stimulant misuse included seven academic motives and three recreational motives, possibly increasing the chances of academic motives being chosen. As previously noted, only 20 of the 201 misusers endorsed a recreational motive, limiting the generalizability of these particular findings. While there is strong evidence for the relation between ADHD symptomology and academic motives for misuse, further research that includes a larger sample of students endorsing recreational motives is needed to provide evidence that this is a unique relation. Finally, symptoms of ADHD were assessed for the past six months, while misuse was assessed for the previous year. Given that symptoms of ADHD are relatively stable, it is unlikely that this adversely impacted our study.

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