4-1-2019

The Relationship Between Social Anxiety and Alcohol and Marijuana Use Outcomes Among Concurrent Users: A Motivational Model of Substance Use

Margo C. Villarosa-Hurlocker
University of New Mexico, margo.villarosa@eagles.usm.edu

Adrian J. Bravo
University of New Mexico, ajbravo@wm.edu

Matthew R. Pearson
University of New Mexico, drmateo@unm.edu

Protective Strategies Study Team

Recommended Citation

The Relationship Between Social Anxiety and Alcohol and Marijuana Use Outcomes among Concurrent Users: A Motivational Model of Substance Use

Margo C. Villarosa-Hurlocker, Ph.D.[*],
Center on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, USA

Adrian J. Bravo, Ph.D.,
Center on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, USA

Matthew R. Pearson, Ph.D., and
Center on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, USA

Protective Strategies Study Team[**]

Abstract

Background: College students with more social anxiety symptoms are particularly vulnerable to problematic alcohol and marijuana use given their susceptibility for elevated anxiety symptoms in social settings combined with the normative nature of substance use. Existing research has established substance use as coping-motivated for these students when examining alcohol and marijuana use problems separately. The next step is to determine whether students with more social anxiety who use both substances do so for similar or different reasons.

Objectives: The current study tested a comprehensive (i.e., all variables in the same model) motivational model of alcohol/marijuana use in a sample of college students from 10 universities across the U.S. who endorsed both past-month alcohol and marijuana use.

Methods: College students were recruited through psychology department participant pools and completed an online survey assessing mental health symptoms, substance use motives, and substances use behaviors. Current sample comprised concurrent alcohol/marijuana users ($n = 2,034$), 29.6% of whom endorsed clinically-indicated levels of social anxiety and nearly one-fourth had exceeded the cutoff for hazardous drinking (23.2%) and hazardous marijuana use (21.9%).

Results: Across both substances, coping motives significantly mediated the positive relationship between social anxiety symptoms and substance use problems. Unique to alcohol, conformity motives mediated the association between social anxiety symptoms and alcohol-related problems.

[*]Corresponding Author: Center on Alcoholism, Substance Abuse, and Addictions, 2650 Yale Blvd SE, Albuquerque, NM, USA 87106, Office: 505-925-2371, Fax: 505-925-2301, mhurlocker@unm.edu.

Conclusions: Taken together, students with more social anxiety who are focused on anxiety management may use either alcohol or marijuana; however, these students may experience more alcohol-related problems when drinking to fit in with peers.

Keywords

college students; social anxiety; substance use motives; drinking problems; marijuana problems

INTRODUCTION

The high comorbidity between social anxiety and alcohol/marijuana use problems is concerning given the extent of functional impairment among individuals with comorbidity as compared to those with either disorder alone (Buckner et al., 2008; Thomas et al., 1999). Understanding the relationship between social anxiety and substance use during the college years is particularly important given that levels of alcohol/marijuana use peak during this time period (Center for Behavioral Health Statistics and Quality, 2015) and individuals with social anxiety are more susceptible to problematic substance use to avoid negative social evaluation (Schry & White, 2013). Further, individuals with subclinical levels of social anxiety are at greater risk for developing an alcohol or cannabis use disorder compared to their less socially anxious peers (Buckner et al., 2008; Crum & Pratt, 2001). The majority of research on social anxiety and substance use outcomes among college students has found that students with more social anxiety symptoms tend to endorse more substance-related problems, regardless of their level of use (Buckner et al., 2007; Schry & White, 2013). Therefore, identifying the underlying factors that account for the associations between social anxiety and problematic substance use is critical for preventing students from developing clinical impairment.

Theoretically, motivational models of substance use assume that individuals with unique psychological characteristics are driven by their underlying need states, particularly when cued by specific environments, which can lead to more substance-related consequences (Cooper et al., 2016). Such an assumption would suggest that individuals with similar psychological characteristics would use multiple substances for similar reasons, with the perception that the substances have similar reinforcement properties and will meet their needs (i.e., convergence; Simons et al., 2000). The extant support for coping-motivated use among students with social anxiety for both alcohol and marijuana would support a convergent pattern of use. Despite the reported overlap in psychological effects of alcohol and marijuana (Buckner et al., 2013) and that expectations of such effects predict use even after accounting for their pharmacological effects (Metrick & Rohsenow, 2013), prior work examining motivational models of marijuana and alcohol separately would suggest students with social anxiety may use these substances for different reasons.

Social anxiety refers to elevated psychological distress and physiological arousal in social situations due to heightened social evaluative fears (Kashdan & Steger, 2006). The etiology of co-occurring social anxiety and substance use problems is commonly attributed to coping-motivated substance use as an underlying mechanism (Buckner et al., 2013). Yet, prior investigations of alcohol or marijuana use have found that students with social anxiety

experience more substance-related problems based on both positively reinforcing (e.g., enhancement; Villarosa et al., 2014) and negatively reinforcing motives (e.g., conformity; Buckner et al., 2012). These inconsistencies may be due to the lack of attention to students who use both alcohol and marijuana (i.e., concurrent users). Although students who use marijuana tend to use alcohol (Mohler-Kuo et al., 2003), findings have been mixed in the association between social anxiety and alcohol-related problems among college student marijuana users (Buckner et al., 2007; Buckner et al., 2011). Given these prior studies have not comprehensively (i.e., all variables in one model) examined the associations among social anxiety, substance use motives, and substance-related problems among concurrent users, it is unclear whether students with social anxiety are using these substances for similar or different reasons. Additionally, the social context in which students use these substances likely differs, particularly for students with social anxiety.

Students with elevated social anxiety tend to perseverate on how they are being evaluated in public, naturally increasing their internal distress and their desire to engage in behaviors consistent with their surroundings (Book & Randall, 2002). Despite some states being less restrictive in their marijuana use laws, fewer social settings permit the use of marijuana, as compared to alcohol, potentially preventing the desired effects these students want to achieve in such settings. There has been preliminary evidence for an effect of coping motives on substance-related problems in a treatment-seeking sample of concurrent users with social anxiety (Foster et al., 2016). Given prior studies have found (1) social anxiety has been significantly associated with almost all substance use motives, to some degree (Buckner et al., 2012; Lewis et al., 2008; Windle & Windle, 2012), and (2) both positive and negative reinforcement motives have independently accounted for the association between social anxiety and substance-related problems (Buckner et al., 2012; Villarosa et al., 2014), it is important to test a motivational model that includes a comprehensive examination of social anxiety (e.g., multiple social anxiety dimensions), substance use motives and substance-related problems to clarify extant literature and inform prevention/intervention efforts for students with more social anxiety.

Existing research has supported coping-motivated substance use as problematic for these students when examining alcohol- and marijuana-related problems separately. The next step is to determine whether students with social anxiety who use both substances do so for similar or different reasons. Thus, the present study tested a comprehensive (i.e., all variables in the same model) motivational model of alcohol- and marijuana-related problems in a large sample of college students who endorsed past-month concurrent alcohol and marijuana use. Although prior work has examined cross-over effects from alcohol/marijuana motives to marijuana/alcohol consequences, respectively (Foster et al., 2016; White et al., 2018), these findings have been inconsistent and investigated based on varying levels of mental health severity (e.g., high vs low stress or depression). Given the theoretical support for the proposed model when examining alcohol or marijuana use separately, we first sought to determine if the model generalizes to concurrent users. We tested a comprehensive model that accounted for typical weekly use of both alcohol/marijuana as well as gender given their impact on substance-related problems in prior studies (Buckner et al., 2011; Norberg et al., 2009). Based on preliminary analyses, we created a latent construct of social anxiety with two commonly used measures (i.e., social interaction anxiety and fear of negative

evaluation) that have been combined to create composite scores in prior work (Norberg et al., 2009; Norberg et al., 2011). Thus, using a structural equation model framework, we expected that coping motives would mediate the positive relationship between social anxiety and both alcohol- and marijuana-related problems. Given inconsistent support for other motives when looking at alcohol or marijuana independently (e.g., Buckner et al., 2012; Villarosa et al., 2014), we also expected different motives would uniquely mediate the relationship between social anxiety and alcohol- and marijuana-related problems.

MATERIALS AND METHODS

Participants and Procedures

Participants were college students (*n*=7,307) recruited to participate in an online survey in exchange for research participation credit from Psychology Department Participant Pools at ten universities across ten U.S. states (for more information of study procedures and sample, see Bravo et al., 2018). To minimize burden on participants, we utilized a planned missing data design, also known as matrix sampling (Graham et al., 2006; Schafer, 1997). For the present study, two measures of social anxiety were given to a random subsample of the total sample. Further, we limited our analytic sample to students that consumed both alcohol and marijuana in the previous month (*n*=2,034). It is important to note that only small mean differences (Cohen, 1992) on consumption, motives, and problem measures were found when comparing our past 30-day concurrent users (*n*=2,034) to past 30-day alcohol-only users (*n*=1,396) and past 30-day marijuana-only users (*n*=170) of the larger sample (see Supplemental Table 1). Among concurrent users, the majority of participants identified as being either White, non-Hispanic (*n*=1,382; 67.95%) or of Hispanic/Latino ethnicity (*n*=323; 15.88%) and female (*n*=1,405; 69.08%), and reported a mean age of 20.24 (*Median*=19.00; *SD*=3.16) years. Study procedures were approved by the institutional review boards at each participating university.

Measures

Social Anxiety.—Social anxiety was assessed using the 20-item Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) and the 12-item Brief Fear of Negative Evaluation (BFNE; Leary, 1983). SIAS assesses interaction anxiety on a 5-point response scale (0=*not at all characteristic or true of me*, 4=*extremely characteristic or true of me*). Example item: "I tense up if I meet an acquaintance in the street" (items were summed). BFNE assesses evaluation fears on a 5-point response scale (1=*not at all characteristic of me*, 5=*extremely characteristic of me*). Example item: "I am afraid others will not approve of me" (items were summed). Both measures have been previously validated among college students (SIAS: α=.88, Mattick & Clarke, 1998; BFNE: α=.88, Rodebaugh et al., 2004) and they demonstrated adequate internal consistency in the current sample (SIAS: α=.93; BFNE: α=.88). Based on our missing-data-by-design procedure, 1,013 (49.80%) participants in our analytic sample completed the SIAS and 1,024 (50.34%) completed the BFNE. Of note, 29.6% of the sample met a cutoff score on the SIAS (score 34) and 29.79% on the BFNE (score 25) for clinically-indicated levels of social anxiety.

Drinking Motives.—Drinking motives were assessed using the 28-item Modified Drinking Motives Questionnaire-Revised (M-DMQ-R; Grant et al., 2007) measured on a 5-point response scale (1=*never/almost never*, 5=*almost always/always*). The measure assesses reasons for drinking within four domains: social, conformity, enhancement, and coping (split into coping with anxiety [DTC-Anxiety] and coping with depression [DTC-Depression]). The M-DMQ-R subscales have demonstrated good psychometric properties in college student samples (e.g., .66<αs<.91; Grant et al., 2007) and in the current sample (.74< αs<. 89). The social, conformity, enhancement, and DTC-Anxiety subscales were used in our analyses (items were averaged). Previous research has shown suppression effects when modeling both DTC-anxiety and DTC-depression in the same model (Bravo & Pearson, 2017); thus only the DTC-anxiety subscale was examined.

Marijuana Use Motives.—Marijuana use motives were assessed using the 25-item Marijuana Motives Questionnaire (MMQ; Simons et al., 1998) measured on a 5-point response scale (1=*almost never/never*, 5=*almost always/always*). The MMQ assesses five distinct marijuana motives: enhancement, conformity, expansion, coping, and social motives (items were averaged). The MMQ subscales have demonstrated good psychometric validity with an adolescent/college student sample (e.g., .76<αs<.84; Chabrol et al., 2005) and in the current sample (.87< αs<.92). Of note, expansion marijuana motives were not included in the proposed analyses given that we did not assess for expansion drinking motives.

Alcohol Use.—Past 30-day alcohol use frequency was assessed with a single item: "On how many days during the last 30 days did you consume alcohol?". Typical quantity was measured with a modified version of the Daily Drinking Questionnaire (DDQ; Collins et al., 1985). Participants indicated how much they drink during a typical week in the past 30 days using a 7-day grid. We summed number of standard drinks consumed on each day of the typical drinking week. We included typical quantity as a covariate in the proposed model because it is one of the strongest predictors of alcohol-related problems (Prince et al., 2018).

Marijuana Use.—Past 30-day marijuana use frequency was assessed with a single item: "On how many days during the last 30 days did you use marijuana?". Typical marijuana use quantity was assessed using the Marijuana Use Grid (MUG, Pearson & Marijuana Outcomes Study Team, 2018), a measure patterned from the DDQ (Collins et al., 1985). Specifically, each day of the week was broken down into six 4-hour blocks of time (12a-4a, 4a-8a, 8a-12p, etc.), and participants indicated the quantity of marijuana they used (in grams) during a "typical week" in the past 30 days during each time block. Initial validation of the MUG has demonstrated concurrent and incremental validity with marijuana-related problems in a sample of college students (Pearson & Marijuana Outcomes Study Team, 2018). We calculated typical quantity of marijuana use by summing the total number of grams consumed across time blocks. Consistent with previous research (Pearson & Marijuana Outcomes Study Team, 2018), values greater than 100g were Winsorized. We examined typical quantity of marijuana use as a covariate in the proposed model to be consistent with our measure of alcohol use.

Alcohol-related Problems.—Past 30-day alcohol-related problems were assessed using the 24-item Brief-Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005). Each item was scored dichotomously to reflect presence/absence of the alcohol-related problem in the past 30 days (0=*no*, 1=*yes;* items were summed). The B-YAACQ has been validated with college student samples (α=.82; Read et al., 2007) and demonstrated adequate internal consistency in the current sample (α=.90). Of note, 23.2% of the sample exceeded the cut-off for probable alcohol use disorder (based on an Alcohol Use Disorder Identification Test score 16; Babor et al., 2001).

Marijuana-related Problems.—Past 30-day marijuana-related problems were assessed using the 21-item Brief Marijuana Consequences Questionnaire (B-MACQ; Simons et al., 2012). Each item was scored dichotomously to reflect presence/absence of the marijuana-related problem in the past 30 days (0=*no*, 1=*yes*; items were summed). The B-MACQ has been validated with college student samples (α=.92; Pearson et al., 2017) and demonstrated adequate internal consistency in the current sample (α=.89). Of note, 21.9% of the sample exceeded the cut-off for probable cannabis use disorder (based on a Cannabis Use Disorder Identification Test-revised score 13; Adamson et al., 2010).

Data Analysis Plan

To test the proposed comprehensive (i.e., all variables in the same model) mediation model, a structural equation model (social anxiety was a latent variable with scores on the SIAS and BFNE as indicators[1]) was conducted (see Figure 1) using M*plus* 7.4 (Muthén & Muthén, 1998–2017). Gender and typical alcohol/marijuana quantity were included as covariates in the model. Since we utilized a missing-data-by-design procedure, missing data were handled using full information maximum likelihood (Muthén & Muthén, 1998–2017). We examined the total, direct, and indirect effects of each predictor variable on substance use problems using 99% bias-corrected bootstrapped estimates (Efron & Tibshirani, 1993) based on 10,000 bootstrapped samples, which provides a powerful test of mediation (Fritz & MacKinnon, 2007). As a measure of effect size for mediated effects, we calculated the relative indirect effect using unstandardized values by dividing the specific indirect effect by the total effect (Preacher & Kelley, 2011).

RESULTS

Descriptive statistics and correlations among study variables are presented in Table 1. On average, participants consumed marijuana (*M*=10.79, *SD*=10.47) more often in the last 30 days than alcohol (*M*=6.72, *SD*=5.25), t(2033)=−16.41, p<.001, d=.436. Among motives that were comparable (i.e., same items used for the subscales), participants reported higher alcohol social motives (*M*=3.63, *SD*=0.89) than marijuana social motives (*M*=2.36, *SD*=1.10), t(1988)=47.97, p<.001, d=1.10 and higher alcohol conformity motives (*M*=1.42, *SD*=0.70) than marijuana conformity motives (*M*=1.37, *SD*=0.72), t(1987)=3.31, p=.001,

---

[1]The measurement model provided an acceptable fit to the data based on most fit indices (Hu & Bentler, 1999), CFI=.973, TLI=.870, RMSEA=.068 (90% CI [.061, .076]), SRMR=.042. It is important to note that two independent mediation models were also conducted with SIAS and BFNE as single variables; however, mediation effects were the same for both social anxiety dimensions and thus we present findings using a single latent social anxiety variable.

d=0.08; but lower alcohol enhancement motives (*M*=3.16, *SD*=0.93) than marijuana enhancement motives (*M*=3.45, *SD*=1.10), *t*(1989)=−11.65, *p*<.001, *d*=0.26.

Mediation Effects

The comprehensive mediation model provided an excellent fit to the data (Hu & Bentler, 1999), CFI=.989, TLI=.962, RMSEA=.037 (90% CI [.030, .045]), SRMR=.019. The total, indirect, and direct effects are summarized in Table 2 and Figure 1.

Shared Mediation Effects.

Across both substances, coping motives significantly mediated the association between social anxiety and substance use problems, accounting for 31.25% of the total effect for alcohol problems and 39.22% of the total effect for marijuana problems. Specifically, more social anxiety symptoms were associated with higher levels of DTC-anxiety/marijuana coping motives which in turn were associated with more alcohol/marijuana-related problems, respectively.

Unique Mediation Effects.

Unique to alcohol-related problems, conformity motives significantly mediated the association between social anxiety and alcohol-related problems, such that social anxiety symptoms were associated with higher levels of conformity motives which in turn were associated with more alcohol-related problems (accounted for 31.25% of the total effect). Although there was a significant mediation effect for enhancement drinking motives, caution should be taken given the non-significant direct effect between enhancement drinking motives and alcohol-related problems. It is important to note that even when controlling for all other predictors, social anxiety was significantly directly associated with more marijuana-related problems but not alcohol-related problems.

Exploratory Test of Differences in Coefficients

Given the same items were used to assess marijuana and alcohol social, enhancement, and conformity motives, we explored whether the associations for all matched paths in the proposed model (e.g., social anxiety ➔ alcohol social motives vs. social anxiety ➔ marijuana social motives) differed across substances. Specifically, we conducted tests of linear restrictions on these parameter estimates (standardized coefficients) using Wald Chi-square test (Muthén & Muthén, 1998–2017). Of the direct paths that were tested for equality that made up mediation effects, only two were significantly different (p<.01) across substances. First, there was a significant difference between social anxiety and enhancement motives such that social anxiety was positively significantly associated with enhancement drinking motives [β=.16] but not significantly associated with enhancement marijuana motives [β=.04]). Second, there was a significant difference between conformity motives on substance-related problems such that conformity motives were positively associated with alcohol-related problems [β=.16] but not associated with marijuana-related problems [β=.01]). We did not conduct comparative analyses with coping because the items comprising alcohol and marijuana coping motives differed.

DISCUSSION

College students with social anxiety symptoms tend to endorse more alcohol- and marijuana-related problems, regardless of their levels of use. Further, these students tend to have poorer outcomes following brief interventions (e.g., Terlecki et al., 2011) highlighting the need to better understand what influences them to engage in risky substance use behaviors. The present study tested a comprehensive motivational model of alcohol- and marijuana-related problems in a large sample of U.S. college students who endorsed both past-month marijuana and alcohol use, and varying levels of social anxiety. As predicted, students with higher levels of social anxiety reported more alcohol- and marijuana-related problems. When including substance use motives in the model, social anxiety was no longer associated with alcohol-related problems, but remained positively associated with marijuana-related problems. Across both substances, social anxiety was most predictive of negative reinforcement motives (coping/conformity motives).

The current findings offer a critical step in examining concurrent substance use in a specific subpopulation of college students. In line with a pattern of convergence between alcohol and marijuana use motives (Newcomb et al., 1988), we found students with higher social anxiety who are using substances to cope with internal distress are endorsing more alcohol- and marijuana-related problems, even after accounting for all substance use motives and quantity. These findings are consistent with prior motivational models of alcohol and cannabis use among adolescents (Patrick et al., 2011). In fact, evidence suggests that students who engage in coping-motivated substance use are more inclined to engage in polysubstance use (Boys & Marsden, 2003). Although suggesting that these substances have similar reinforcement properties for these students, it may also be that students with higher social anxiety are more focused on using either substance to cope with their anxiety symptoms rather than to experience the actual effects of the specific substances (Simons et al., 2000). Given that students with higher social anxiety experience more substance-related problems, regardless of their level of use, they may rely on substances to cope in social situations and avoid substance-free situations (e.g., Buckner & Heimberg, 2010; Buckner et al., 2012).

Yet, marijuana and alcohol have unique pharmacological properties and varying levels of societal acceptance that can impact whether an individual uses a given substance to meet a desired need (i.e., divergence; Newcomb et al., 1988). Divergence in substance use seems particularly relevant for students with social anxiety, given their internal distress is driven by perceptions of their own behavior and of how others are judging their behavior in public settings. Current findings lend support to a pattern of divergence in substance use motives, such that conformity drinking motives accounted for the social anxiety – alcohol problems association, but not the social anxiety – marijuana problems association. Collectively, although students with higher social anxiety appear to use marijuana and alcohol for similar reasons, there were some differences in how specific motivations may lead to experiencing substance-related problems.

Consistent with the current study, several prior investigations support the mediating role of conformity drinking motives on the social anxiety – alcohol-related problems relationship

(e.g., Lewis et al., 2008; Stewart et al., 2006). Conformity motives refers to using substances to fit in with peers. Although preliminary work has found support for marijuana conformity motives as a mediator in the association between social anxiety and marijuana-related problems (Buckner et al., 2012), there are several reasons conformity motives may account for the association between social anxiety and alcohol-related problems, but not marijuana-related problems. First, alcohol is a legal substance that is more visible and accepted as compared to marijuana. Across college campuses, alcohol use is considered a normative, socially approved behavior, likely leading students with higher social anxiety to believe they will be accepted if they consume alcohol (Stewart et al., 2006). Second, there are more social situations that permit alcohol use, likely influencing college students decision to consume alcohol over marijuana in certain situations. Third, despite the looser restrictions to marijuana laws in several states, marijuana use is still not normative in that the majority of college students do not currently use marijuana (~26% endorsed past-month marijuana use; Pearson et al., 2017), and there remains uncertainty surrounding how others may perceive marijuana use.

Clinical Implications

The current findings offer insight on how to improve prevention and intervention efforts for students with social anxiety. Given these students tend to have poorer outcomes following brief motivational interventions compared to their less anxious peers (Terlecki et al., 2011), an important first step is to identify those students who are engaging in problematic substance use and experiencing mental health symptoms. Exploring how these students' emotional issues relate to their reasons for using substances can inform what contributes to these students' problematic use patterns. The reinforcing effects of both alcohol and marijuana on anxiety symptoms suggests a benefit of evaluating concurrent use, even if clinical efforts are geared more toward one substance. Brief motivational interventions utilize a harm-reduction approach such that students are encouraged to share the reasons that they use substances and through such discussions, students can consider how to achieve their goals (e.g., comfort in social situations) while also mitigating substance-related harm.

Strengths and Limitations

It is important to consider the relative strengths and limitations of the present study. Although we obtained a large sample of concurrent-using college students that provided adequate statistical power to test a comprehensive motivational model alcohol- and marijuana-related problems, our methodology did not ensure that our sample is nationally-representative, limiting the potential generalizability of our findings. Relatedly, we only recruited volunteer students from psychology courses which likely does not reflect the representativeness of college students who are concurrent users or have higher social anxiety. Further, the small total effects of social anxiety on substance-related problems, in addition to the significant positive association between social anxiety and marijuana-related problems after including marijuana use motives suggests other psychosocial factors may contribute to the problematic substance use of these students. Students with social anxiety are typically driven by their experience of internal distress and need for external approval (Book & Randall, 2002), which helps clarify why coping-motivated use was the most strongly associated with social anxiety. Yet, we failed to consider the high co-occurrence of

depression or the social contexts in which these students engage in substance use. Moving forward, it would be helpful to determine what conditions may influence these students to engage in (problematic) alcohol or marijuana use.

By examining a comprehensive motivational model of alcohol and marijuana among concurrent using students, the present study replicates and extends findings that have examined only alcohol or only marijuana. Despite using a validated measure of marijuana use quantity, the MUG focused on amount of grams participants' used without querying the various forms of marijuana (e.g., leaf, concentrates, edibles). Future researchers should query about marijuana use more comprehensively to obtain quantity estimates for the varying forms of marijuana (Cuttler & Spradlin, 2017). Relatedly, despite the psychometric support for the substance use motives measures (Chabrol et al., 2005; Grant et al., 2007), the coping subscales across these measures contained different item content, preventing us from examining whether these motives differ between alcohol and marijuana use. Future work comparing motive endorsement across substances should use measures that contain the same item content. Importantly, our cross-sectional study design prevented us from making any causal inferences of study findings. This is especially problematic when testing a mediational model, which assumes a specific temporal order among constructs. Although the wealth of epidemiological work on comorbid social anxiety and substance use disorders (e.g., Grant et al., 2004) supports our proposed model, more experimental and longitudinal research is needed to better understand the underlying cause for the high comorbidity. For example, ecological momentary assessment (EMA) can examine the associations between social anxiety, substance use motives, and substance-related outcomes in near real-time, which can mitigate retrospective recall bias, evaluate the potential cross-over effects between substance use motives and substance use outcomes, and increase confidence in current findings (Shrier & Scherer, 2014). Experimentally, researchers can randomly assign students with social anxiety to different social contexts and then examine their substance use decisions to better understand if these students are using marijuana and alcohol for similar or different reasons.

Conclusions

The current study is the first, to our knowledge, to test a comprehensive motivational model of social anxiety and alcohol- and marijuana-related problems in a sample of college students who use both alcohol and marijuana. Despite evidence that students who use marijuana tend to also use alcohol, no prior work has assessed both alcohol and marijuana use outcomes in relation to social anxiety and motives in a large, multi-site sample of college students. Importantly, when examining a wide range of substance use motives and both alcohol/marijuana use outcomes, these findings replicate and expand on extant research supporting patterns of both convergence and divergence regarding reasons for using marijuana and alcohol among concurrent users (Simons et al., 2000). Broadly, students with higher social anxiety who are focused on anxiety management may use either alcohol or marijuana. Yet, for these students, drinking as a means to fit in may be more likely to lead to alcohol-related problems. Collectively, prevention and intervention efforts would benefit from determining the intrapersonal and interpersonal predictors of substance use among students with social anxiety and then targeting the prominent reasons leading to problematic

outcomes. Importantly, expanding investigations to the determinants and consequences of students using multiple substances is critical to facilitate adaptive functioning and prevent clinical-levels of impairment across the spectrum of mental health issues.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments:

REFERENCES

Adamson SJ, Kay-Lambkin FJ, Baker AL, Lewin TJ, Thornton L, Kelly BJ, Sellman JD (2010) An improved brief measure of cannabis misuse: The Cannabis Use Disorders Identification Test-Revised (CUDIT-R). Drug Alcohol Depend 110:137–143. [PubMed: 20347232]

Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG (2001) The alcohol use disorders identification test (AUDIT) manual: Guidelines for use in primary care 2nd edition, Department of Mental Health and Substance Dependence. World Health Organization, Geneva, WHO/MSD/MSB/01.6A:4–32nd

Book SW, Randall CL (2002) Social anxiety disorder and alcohol use. Alcohol Res Health 26:130–135.

Boys A, Marsden J (2003) Perceived functions predict intensity of use and problems in young polysubstance users. Addiction 98:951–963. [PubMed: 12814501]

Bravo AJ, Villarosa-Hurlocker MC, Pearson MR, Protective Strategies Study Team (2018) College student mental health: An evaluation of the DSM-5 Self-rated Level 1 Cross-Cutting Symptom Measure. Advanced online publication. Psychol Assess doi: 10.1037/pas0000628

Bravo AJ, Pearson MR (2017) In the process of drinking to cope among college students: an examination of specific vs. global coping motives for depression and anxiety symptoms. Addict Behav 73:94–98. doi: 10.1016/j.addbeh.2017.05.001 [PubMed: 28500907]

Buckner JD, Bonn-Miller MO, Zvolensky MJ, Schmidt NB (2007) Marijuana use motives and social anxiety among marijuana-using young adults. Addict Behav 32:2238–2252. doi: 10.1016/j.addbeh.2007.04.004 [PubMed: 17478056]

Buckner JD, Heimberg RG (2010) Drinking behaviors in social situations account for alcohol-related problems among socially anxious individuals. Psychol Addict Behav 24:640–648. [PubMed: 21198225]

Buckner JD, Heimberg RG, Ecker AH, Vinci C (2013) A biopsychosocial model of social anxiety and substance use. Depress Anxiety 30:276–284. doi: 10.1002/da.22032 [PubMed: 23239365]

Buckner JD, Heimberg RG, Matthews RA, Silgado J (2012) Marijuana-related problems and social anxiety: The role of marijuana behaviors in social situations. Psychol Addict Behav 26:151–156. [PubMed: 22004129]

Buckner JD, Heimberg RG, Schmidt NB (2011) Social anxiety and marijuana-related problems: The role of social avoidance. Addict Behav 36:129–132. [PubMed: 20832947]

Buckner JD, Schmidt NB, Lang AR, Small JW, Schlauch RC, Lewinsohn PM (2008) Specificity of social anxiety disorder as a risk factor for alcohol and cannabis dependence. J Psychiatr Res 42:230–239. doi: 10.1016/j.jpsychires.2007.01.002 [PubMed: 17320907]

Buckner JD, Zvolensky MJ, Schmidt NB (2012) Cannabis-related impairment and social anxiety: The roles of gender and cannabis use motives. Addict Behav 37:1294–1297. [PubMed: 22766487]

Center for Behavioral Health Statistics and Quality (2015) 2014 national survey on drug use and health: Detailed tables Substance Abuse and Mental Health Services Administration, Maryland.

Chabrol H, Duconge E, Casas C, Roura C, Carey KB (2005) Relations between cannabis use and dependence, motives for cannabis use and anxious, depressive and borderline symptomatology. Addict Behav 30:829–840. doi: 10.1016/j.addbeh.2004.08.027 [PubMed: 15833585]

Cohen J (1992) A power primer. Psychol Bull 112:155 – 159. doi: 10.1037/0033-2909.112.1.155 [PubMed: 19565683]

Collins RL, Parks GA, Marlatt GA (1985) Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. J Consult Clin Psychol 53:189–200. doi: 10.1037/0022-006X.53.2.189 [PubMed: 3998247]

Cooper ML, Kuntsche E, Levitt A, Barbar LL, Wolf S (2016) Motivational models of substance use: A review of theory and research on motives for using alcohol, marijuana, and tobacco. In Sher KJ (Ed.), The Oxford handbook of substance use disorders (Vol 1, pp. 1–53). New York, NY: Oxford University Press doi: 10/1093/osfordhb/9780199381678.013.017

Crum RM, Pratt LA (2001) Risk of heavy drinking and alcohol use disorders in social phobia: A prospective analysis. Am J Psychiatry 158:1693–1700. doi: 10.1176/appi.ajp.158.10.1693 [PubMed: 11579004]

Cuttler C, Spradlin A (2017) Measuring cannabis consumption: Psychometric properties of the daily sessions, frequency, age of onset, and quantity of cannabis use inventory (DFAQ-CU). PloS One 12:e0178194. doi: 10.1371/journal.pone.0178194 [PubMed: 28552942]

Efron B, Tibshirani RJ (1993) An introduction to the bootstrap Vol. 57 CRC press.

Foster DW, Buckner JD, Schmidt NB, Zvolensky MJ (2016) Multi-substance use among treatment-seeking smokers: Synergistic effects of coping motives for cannabis and alcohol use and social anxiety/depressive symptoms. Subst Use Misuse 51:165–178. doi: 10.3109/10826084.2015.1082596 [PubMed: 26846421]

Fritz MS, MacKinnon DP (2007) Required sample size to detect mediated effect. Psychol Sci:18, 233–239. doi: 10.1111/j.1467-9280.2007.01882.x [PubMed: 17444920]

Graham JW, Taylor BJ, Olchowski AE, Cumsille PE (2006) Planned missing data designs in psychological research. Psychol Methods 11:323–343. doi:10.1037/1082-989X.11.4.323 [PubMed: 17154750]

Grant BF, Stinson FS, Dawson DA, Chou P, Dufour MC, Compton W, Pickering RP, Kaplan K (2004) Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders. Arch Gen Psychiatry 16:807–816

Grant VV, Stewart SH, O'Connor RM, Blackwell E, Conrod PJ (2007) Psychometric evaluation of the five-factor Modified Drinking Motives Questionnaire—Revised in undergraduates. Addict Behav 32:2611–2632. doi: 10.1016/j.addbeh.2007.07.004 [PubMed: 17716823]

Hu L, Bentler PM (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Modeling 6:1–55. doi: 10.1080/10705519909540118\

Kahler CW, Strong DR, Read JP (2005) Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The Brief Young Adult Alcohol Consequences Questionnaire. Alcohol Clin Exp Res 29:1180–1189. doi: 10.1097/01.ALC.0000171940.95813.A5 [PubMed: 16046873]

Kashdan TB, Steger MF (2006) Expanding the topography of social anxiety. Psych Science 17:120–128. doi: 10.1111/j.1467-9280.2006.01674.x

Leary MR (1983) A brief version of the Fear of Negative Evaluation Scale. Pers Soc Psychol Bull 9:371–375. doi: 10.1177/0146167283093007

Lewis MA, Hove MC, Whiteside U, Lee CM, Kirkeby BS, Oster-Aaland L … Larimer ME (2008) Fitting in and feeling fine: Conformity and coping motives as mediators of the relationship between social anxiety and problematic drinking. Psychol Addict Behav 22:58–67. 10.1037/0893-164X.22.1.58 [PubMed: 18298231]

Mattick RP, Clarke JC (1998) Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. Behav Res Ther 36:455–470. doi: 10.1016/S0005-7967(97)10031-6 [PubMed: 9670605]

Metrik J, Rohsenow DJ (2013) Understanding the role of substance expectancies in addiction, in The Wiley-Blackwell handbook of addiction psychopharmacology (MacKillop J, de With H eds), pp 459–487. John Wiley & Sons, Massachusetts.

Mohler-Kuo M, Lee JE, Wechsler H (2003) Trends in marijuana and other illicit drug use among college students: Results from 4 Harvard School of Public Health college alcohol study surveys: 1993–2001. J Am Coll Health 52:17–24. [PubMed: 14717576]

Muthén LK Muthén BO (1998–2017) Mplus user's guide 9th ed Muthén & Muthén, California.

Newcomb MD, Chou C, Bentler PM, Huba GJ (1988) Cognitive motivations for drug use among adolescents: Longitudinal tests of gender differences and predictors of change in drug use. J Counsel Psych 35:426–438.

Norberg MM, Norton AR, Olivier J (2009) Refining measurement in the study of social anxiety and student drinking: Who you are and why you drink determines your outcomes. Psychol Addict Behav 23:586–597. [PubMed: 20025365]

Norberg MM, Olivier J, Alperstein DM, Zvolensky MJ, & Norton AR (2011). Adverse consequences of student drinking: The role of sex, social anxiety, and drinking motives. Addictive Behaviors, 2011, 821–828.

Patrick ME, Schulenberg JE, O'Malley PM, Johnston LD, Bachman JG (2011) Adolescents' reported reasons for alcohol and marijuana use as predictors of substance use and problems in adulthood. J Stud Alcohol Drugs 72:106–116. [PubMed: 21138717]

Pearson MR, Liese BS, Dvorak RD, Marijuana Outcomes Study Team (2017) College student marijuana involvement: Perceptions, use, and consequences across 11 college campuses. Addict Behav 66:83–89. doi: 10.1016/j.addbeh.2016.10.019 [PubMed: 27894029]

Pearson MR, Marijuana Outcomes Study Team (2018) Marijuana Use Grid: A brief, comprehensive measure of marijuana use.

Preacher KJ, Kelley K (2011) Effect size measures for mediation models: quantitative strategies for communicating indirect effects. Psychol Methods 16:93–115. doi: 10.1037/a0022658 [PubMed: 21500915]

Prince MA, Pearson MR, Bravo AJ, Montes KS (2018) A quantification of the alcohol use-consequences association in college student and clinical populations: A large, multi-sample study. Am J Addict 27:116–123. [PubMed: 29356194]

Read JP, Merrill JE, Kahler CW, Strong DR (2007) Predicting functional outcomes among college drinkers: Reliability and predictive validity of the young adult alcohol consequences questionnaire. Addict Behav 32:2597–2610. [PubMed: 17706888]

Rodebaugh TL, Woods CM, Thissen DM, Heimberg RG, Chambless DL, Rapee RM (2004) More information from fewer questions: The factor structure and item properties of the original and brief fear of negative evaluation scale. Psychol Assess 16:169–181. [PubMed: 15222813]

Schafer JL (1997) Analysis of incomplete multivariate data Chapman Hall, New York.

Shrier LA, Scherer EB (2014) It depends on when you ask: Motives for using marijuana assessed before versus after a marijuana use event. Addict Behav 39:1759–1765. Doi: 10.1016/j.addbeh. 2014.07.018 [PubMed: 25123342]

Schry AR, & White SW (2013). Understanding the relationship between social anxiety and alcohol use in college students: A meta-analysis. Addictive Behaviors, 38, 2690–2706. doi: 10.1016/j.addbeh. 2013.06.014 [PubMed: 23906724]

Simons J, Correia CJ, Carey KB (2000) A comparison of motives for marijuana and alcohol use among experienced users. Addict Behav 25:153–160. doi: 10.1016/S0306-4603(98)00104-X [PubMed: 10708331]

Simons J, Correia CJ, Carey KB, Borsari BE (1998) Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. J of Couns Psychol 45:265–273. doi: 10.1037/0022-0167.45.3.265

Simons JS, Dvorak RD, Merrill JE, Read JP (2012) Dimensions and severity of marijuana consequences: Development and validation of the Marijuana Consequences Questionnaire (MACQ). Addict Behav 37:613–621. [PubMed: 22305645]

Stewart SH, Morris E, Mellings T, Komar J (2006) Relations of social anxiety variables to drinking motives, drinking quantity and frequency, and alcohol-related problems in undergraduates. J Ment Health 15:671–682.

Terlecki MA, Buckner JD, Larimer ME, Copeland AL (2011) The role of social anxiety in a brief alcohol intervention for heavy-drinking college students. J Cogn Psychother 25:7–21.

Thomas SE, Thevos AK, Randall CL (1999) Alcoholics with and without social phobia: A comparison of substance use and psychiatric variables. J Stud Alcohol 60:472–479. [PubMed: 10463803]

Villarosa MC, Madson MB, Zeigler-Hill V, Noble JJ, Mohn RS (2014) Social anxiety symptoms and drinking behaviors among college students: The mediating effects of drinking motives. Psychol Addict Behav 28:710–718. [PubMed: 24841178]

White HR, Anderson KG, Beardslee J (2018) Stress as a moderator of the effects of coping motives on alcohol and marijuana use in young adulthood. Cannabis 1:1–13.

Windle M, Windle RC (2012) Testing the specificity between social anxiety disorder and drinking motives. Addict Behav 37:1003–1008. doi: 10.1016/j.addbeh.2012.04.009 [PubMed: 22626889]
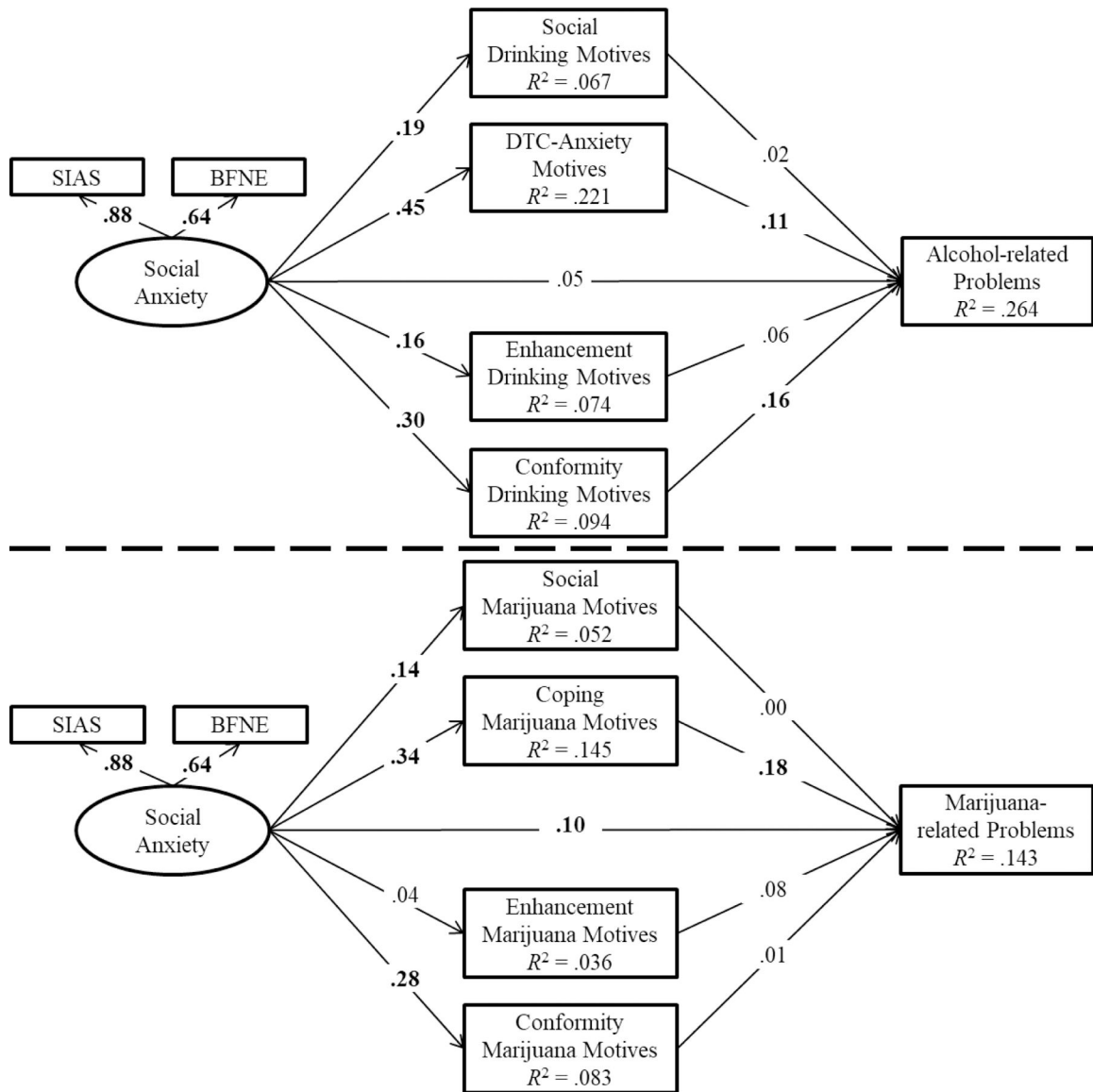
Figure 1.
Depicts the standardized effects of the simultaneous model predicting alcohol and marijuana outcomes. For clarity, we split the figure by substance although all variables were entered into the same model. Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. The effects of covariates (i.e., gender and alcohol/marijuana consumption) are not shown in the figure for parsimony but are available upon request from the authors.

Table 1

Bivariate correlations and descriptive statistics among all study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	M	SD
1. Social Interaction Anxiety	---															24.82	15.05
2. Fear of Negative Evaluation	**.56**	---														33.35	9.57
3. ALC: Social Motives	**.15**	**.13**	---													3.63	0.89
4. ALC: DTC-Anxiety Motives	**.39**	**.29**	**.48**	---												2.47	0.96
5. ALC: Enhancement Motives	**.13**	**.10**	**.63**	**.53**	---											3.16	0.93
6. ALC: Conformity Motives	**.26**	**.18**	**.16**	**.40**	**.18**	---										1.42	0.70
7. MJ: Social Motives	**.11**	**.09**	**.31**	**.27**	**.26**	**.26**	---									2.36	1.10
8. MJ: Coping Motives	**.30**	**.21**	**.16**	**.45**	**.21**	**.31**	**.53**	---								2.07	1.08
9. MJ: Enhancement Motives	.01	.06	**.26**	**.16**	**.37**	–.01	**.49**	**.39**	---							3.45	1.10
10. MJ: Conformity Motives	**.24**	**.17**	**.12**	**.29**	**.13**	**.63**	**.38**	**.39**	.02	---						1.37	0.72
11. ALC: Consumption	–.07	–.02	**.19**	**.15**	**.24**	.06	.04	.01	.08	.07	---					8.39	8.02
12. ALC: Problems	**.11**	**.08**	**.22**	**.29**	**.26**	**.25**	**.10**	**.17**	.03	**.25**	**.44**	---				6.98	5.50
13. MJ: Consumption	–.00	–.08	–.02	.02	.04	.08	**.18**	**.18**	**.17**	**.09**	**.16**	**.12**	---			7.30	14.13
14. MJ: Problems	**.14**	**.08**	**.09**	**.12**	**.08**	**.11**	**.19**	**.29**	**.19**	**.15**	**.11**	**.29**	**.26**	---		3.43	4.11
15. Gender	.07	.06	–.02	.01	–.01	–.05	–.08	.02	–.07	–.05	**–.22**	–.00	**–.15**	**–.14**	---	0.69	0.46

Note. Gender was coded 0 = men, 1 = women. Significant correlations are in bold typeface for emphasis and were determined by a 99% bias-corrected bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. ALC = Alcohol; MJ = Marijuana; DTC = Drinking to Cope.

Table 2

Summary of total, indirect, and direct effects of social anxiety on substance use problems via substance use motives

Outcome Variables:	*Alcohol-related Problems*	
Predictor: *Social Anxiety*	**β**	**99% CI**
Total	**.16**	**0.08, 0.23**
Total indirect[a]	**.11**	**0.08, 0.15**
Social Drinking Motives	.003	−0.01, 0.02
Drinking to Cope-Anxiety Motives	**.05**	**0.02, 0.09**
Enhancement Drinking Motives	**.01**	**0.000, 0.02**[*]
Conformity Drinking Motives	**.05**	**0.03, 0.08**
Direct	.05	−0.04, 0.14
Outcome Variables:	*Marijuana-related Problems*	
Predictor: *Social Anxiety*	β	99% CI
Total	**.16**	**0.09, 0.24**
Total indirect[a]	**.07**	**0.04, 0.10**
Social Marijuana Motives	.000	−0.01, 0.01
Coping Marijuana Motives	**.06**	**0.04, 0.09**
Enhancement Marijuana Motives	.003	−0.003, 0.01
Conformity Marijuana Motives	.002	−0.02, 0.03
Direct	**.10**	**0.01, 0.18**

Note. Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero.

[a]Reflects the combined indirect associations within the model. The effects of covariates (i.e., gender and alcohol/marijuana consumption) are not shown but are available upon request from the authors.

[*] caution should be taken interpreting this indirect effect given non-significant direct effect between enhancement drinking motives and alcohol-related problems.