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# Examining the Relation Between Social Anxiety and Cannabis Problems Among College Students Through Coping-Related Expectancies and Motives

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**Objective:** College students high in social anxiety are at increased risk for cannabis-related problems. This may be particularly true when they hold strong coping-related expectancies and motives for cannabis. However, few studies have examined these constructs together in accordance with the motivational model, which posits that substance use is proximally influenced by motives and more distally influenced by expectancies. Thus, the current study examined whether the relation between social anxiety and cannabis-related problems was indirectly explained through coping-related expectancies, motives, and cannabis use. **Method:** Past-month cannabis users ($N$ = 660; 71.6% female, 47.3% white non-Hispanic) from seven U.S. universities completed an online survey assessing social anxiety, and cannabis use frequency, problems, expectancies, and motives. A saturated path model examined social anxiety as a predictor of cannabis problems via coping-related expectancies and motives, and cannabis frequency. **Results:** There was a positive indirect effect of social anxiety on cannabis problems through cognitive and behavioral impairment expectancies, depression coping motives, and cannabis use. Social anxiety also indirectly positively related to cannabis problems via social and sexual facilitation expectancies, social anxiety coping motives, and cannabis use. Further, social anxiety indirectly positively related to cannabis problems through relaxation and tension reduction expectancies, both depression and social anxiety coping motives, and cannabis use. These indirect effects were invariant by sex assigned at birth. **Conclusions:** Results support using a theory-informed model of coping-related cannabis cognitions to understand the relation between social anxiety and cannabis problems. Interventions that modify coping-related cognitions may reduce cannabis-related problems in college students high in social anxiety.

**Key words**: = cannabis; social anxiety; college students; expectancies; motives

National estimates indicate that traditional-aged college students (i.e., 18-25 years of age) have the highest rates of cannabis use (Center for Behavioral Health Statistics and Quality, 2021). In fact, national surveys suggest that nearly half of college students report past-year cannabis use, with 25% reporting past-month use (Schulenberg et al., 2020). Cannabis use is associated with a variety of academic/occupational, social, legal, psychological, and physical health consequences (e.g., Korn et al., 2018; Pearson et al., 2017; Volkow et al., 2014). Prior work has found that 90.8% of past-month college student cannabis users experienced at least one consequence from their cannabis use (Pearson et al., 2017). Thus, college students represent an important group to study with regard to cannabis use. Concerningly, college students with high levels of social anxiety (i.e., a fear of being negatively evaluated in social situations) appear to be particularly susceptible to

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experiencing cannabis problems, despite using cannabis at similar rates as students low in social anxiety (Single et al., 2022).

Social anxiety is characterized by both high negative affect and low positive affect (Brown et al., 1998). Relative to other anxiety disorders, low positive affect is unique to social anxiety and appears more closely related to the characteristics of depression (Kashdan, 2007). College students high in social anxiety may be compelled to use cannabis to modify both their high negative and low positive affective states (Buckner et al., 2013; Walukevich-Dienst et al., 2020), potentially as a form of self-medication (Khantzian, 1997). Further, research on the pharmacological effects of cannabis demonstrates that cannabis can produce acute anxiolytic effects (Crippa et al., 2009), suggesting that social anxiety may pose a salient risk for cannabis use because of the desire to reduce anxiety in social situations. As such, college students who are high in social anxiety may be particularly motivated to use cannabis based on their expectations for certain coping-related drug effects, which are known to be associated with greater risk for problems (e.g., Foster et al., 2016).

Cannabis expectancy effects refer to beliefs regarding the anticipated outcomes of cannabis use, and have been found to relate to different patterns of cannabis use (e.g., Brackenbury et al., 2016). These expectancies can be broadly understood as higher-order positive (i.e., desirable) and negative (i.e., undesirable) effects (Goldman, 1994). Positive expectancies tend to be positively associated with cannabis use and problems, and negative expectancies are associated with lower use and abstinence (Brackenbury et al., 2016; Hayaki et al., 2010). However, in some cases negative expectancies may be associated with greater use and problems, likely reflecting increased exposure to or experience with the drug (Buckner & Schmidt, 2008). Higher-order expectancy factors are each comprised of several lower-order factors that provide a more nuanced understanding of expected effects (Goldman, 1994). Cognitive and behavioral impairment (e.g., slowing one's thinking and actions), social and sexual facilitation (e.g., talking more than usual), and relaxation and tension reduction (e.g., feeling calm) are three lower-order expectancy factors that may be exceptionally relevant in understanding why students high in social anxiety may use cannabis to reduce social anxiety symptoms.

Though cognitive behavioral impairment is a negative expectancy, holding strong cognitive behavioral impairment expectancies may positively relate to cannabis use, and subsequently problems, due to the expectation that cannabis will slow down anxious thoughts and change perceptions of social situations in the moment (Schafer & Brown, 1991). Prior work examining this notion has been mixed, as Buckner and Schmidt (2009) found that cognitive behavioral impairment expectancies mediated the positive relation between social anxiety and cannabis problems among undergraduate students, though this effect was not replicated in another sample (Buckner & Schmidt, 2008). As such, more work is needed to examine whether cognitive behavioral impairment expectancies can explain the relation between social anxiety and cannabis use and problems. In addition, social and sexual facilitation expectancies may positively relate to cannabis use due to the expectation that cannabis will function as a social lubricant and help foster social interactions that individuals would usually be too anxious to initiate or participate in. To date, little research has examined relations between social and sexual facilitation, social anxiety, and cannabis use and problems. One study of college students did not find significant associations between social anxiety and social and sexual facilitation expectancies (Buckner & Schmidt, 2008), while another found that social and sexual facilitation expectancies mediated the negative relation between social anxiety and cannabis use (Di Blasi et al., 2015). Yet, relations between social and sexual facilitation expectancies and cannabis problems have not been examined. Finally, individuals high in social anxiety may endorse strong relaxation and tension reduction expectancies, expecting that cannabis will reduce anxious tension in social situations and help manage negative affect. Again, limited research has examined relations between social anxiety, relaxation and tension reduction expectancies, and cannabis use and problems, yielding mixed results. For example, Buckner and Schmidt (2008) found that social anxiety was negatively related to relaxation and tension reduction expectancies, whereas Buckner and Schmidt (2009) failed to

find a significant relation between social anxiety and relaxation and tension reduction expectancies. Given the limited nature of extant work examining social anxiety-relevant coping expectancies on the relation between social anxiety and cannabis use and problems, further research is warranted.

Importantly, though expectancies are known to relate to substance use and problems, Cox and Klinger's (1988) motivational model indicates that they are not the most proximal predictor of these outcomes. Instead, expectancies relate to substance use motives, or reasons for using, which are conceptualized as the final common pathway to use. Thus, cannabis use behaviors can be understood as being influenced by expectancies, with motives mediating this relationship (Foster et al., 2016). More specifically, emotion-focused motives, such as coping (i.e., to alleviate negative mood) motives, have been found to be the most influential motives in predicting cannabis use and cannabis-related problems (Bravo et al., 2019; Phillips et al., 2017). Cannabis coping motives are particularly relevant for those high in social anxiety because individuals may use cannabis to cope with social anxiety-related negative affect. Accordingly, research finds that coping motives play a causal role in the link between social anxiety and cannabis problems, including among undergraduate students (Buckner et al., 2007; 2012). Of note, this work has only examined coping motives as a broad construct related to general negative mood. Lee and colleagues (2009) proposed that cannabis coping motives should be differentiated into motives to cope with negative/depressed mood and motives to cope with social anxiety. Teasing apart these motives may be particularly relevant to understanding the relation between social anxiety and cannabis problems, given that individuals high in social anxiety may be prone to using cannabis to manage their emotions, though potentially not in the same way for both depression and anxiety. As no research to date has examined these better-specified coping motives, it represents an important area for further investigation.

Considering that prior work has demonstrated indirect paths from social anxiety and cannabis use and problems through either expectancies and motives separately, it is important to examine these constructs together to clarify the literature and inform intervention efforts designed to reduce cannabis problems among individuals with social anxiety. However, a comprehensive model theoretically informed by Cox and Klinger's (1998) motivational model has yet to be examined. In addition, it remains unknown whether certain expectancies and motives that may be particularly relevant to social anxiety explain the relation between social anxiety and cannabis problems. Thus, the purpose of the current study was to examine whether the relation between social anxiety and cannabis-related problems was indirectly explained through coping-related motives and expectancies (i.e., those related to managing social anxiety symptoms). Informed by prior work and theory, we posited that there would be unique paths through which social anxiety and cannabis problems would be indirectly explained based on type of expectancy and motive. We hypothesized a positive indirect association between social anxiety and cannabis problems through cognitive behavioral impairment expectancies, depression coping motives, and cannabis use (social anxiety → cognitive behavioral impairment expectancies → depression coping motives → cannabis use → cannabis problems). In addition, we hypothesized that social anxiety would indirectly relate to cannabis problems via stronger social and sexual facilitation expectancies, greater social anxiety coping motives, and increased cannabis use (social anxiety → social and sexual facilitation expectancies →social anxiety coping motives → cannabis use → cannabis problems). Moreover, we hypothesized that social anxiety would indirectly relate to cannabis problems via stronger relaxation and tension reduction expectancies, greater social anxiety coping motives, and increased cannabis use (social anxiety → relaxation and tension reduction expectancies → social anxiety coping motives → cannabis use → cannabis problems). Lastly, we tested model invariance across sex assigned at birth, given that prior research has found sex/gender differences with both cannabis use and social anxiety. Specifically, college men use cannabis at greater frequencies than college women (e.g., Park et al., 2022), and women are more likely to have a social anxiety diagnosis than men (for a review, see Asher et al., 2017). We did not posit any hypotheses related to sex invariance testing, as these analyses were exploratory.

## METHODS

### *Participants and Procedures*

Participants were 660 college students from seven universities in the United States who reported past-month cannabis use. Students were recruited via Psychology Department participant pools during the 2019-2020 academic year (for more information see Looby et al., 2021), and were compensated with research credit in psychology courses. After providing informed consent, students completed an online survey assessing their substance use and mental health, including cannabis use, problems, expectancies, and motives. This study was approved by the University of Wyoming Institutional Review Board. Participants had a mean age of 19.69 years (*SD* = 2.85) and were largely assigned female sex at birth (72.6%). The majority of the sample was white non-Hispanic (47.6%), followed by multi-racial/ethnic (26.4%), Black/African American (13.5%). Hispanic/Latinx (7.4%), Asian (3%), Other (1.4%), American Indian/Alaska Native (0.5%), and Native Hawaiian/Pacific Islander (0.2%).

### *Measures*

*Cannabis Use.* The Marijuana Use Grid (MUG; Pearson & Marijuana Outcomes Study Team, 2018) assessed past-month weekly cannabis use in any form (e.g., flower, edibles, concentrates, etc.). The MUG assessed cannabis use using a grid measure in which each day of the week was broken down into six 4-hour time blocks (12am-4am, 4am-8am, 8am-12pm, etc.). Participants were asked to report their quantity of use within each time block that occurred for any form of cannabis in a "typical week." Cannabis use frequency was calculated by summing the total number of time blocks for which they reported using any amount during a typical week (range: 0-42), with higher scores reflecting greater cannabis use frequency.

*Cannabis Problems*. The 21-item Brief Marijuana Consequences Questionnaire (B-MACQ; Simons et al., 2012) assessed past-month cannabis problems. Example items include "I have been unhappy because of my marijuana use," "When using marijuana I have done impulsive things that I regretted later," and "I have become very rude, obnoxious, or insulting after using marijuana." Participants answered whether or not they experienced each cannabis problem using a dichotomous "Yes" or "No" response format. Number of consequences endorsed were summed to create a total problems score (α = 0.90).

*Cannabis Expectancies.* The 48-item Marijuana Effect Expectancy Questionnaire (MEEQ; Schafer & Brown, 1991) assessed cannabis expectancies. Example items include "Marijuana slows my thinking and actions," "I'm more social when I use marijuana," and "Marijuana makes me calm." Participants indicated the extent to which they believed or expected each cannabis-related outcome to occur if they were to use cannabis, using a five-point scale (1 = disagree strongly, 5 = agree strongly). The MEEQ assesses six lower-order expectancies, but for the purpose of the present study, only the relaxation and tension reduction (α = 0.86), social and sexual facilitation (α = 0.75), and cognitive behavioral impairment (α = 0.83) factors were included in the model. Items for each factor were summed and averaged, with higher scores indicating stronger expectancies.

*Cannabis Motives.* The Comprehensive Marijuana Motives Questionnaire (CMMQ; Lee et al., 2009) assessed past-month cannabis motives. This 36-item measure assesses 12 different motives for cannabis use, with items rated along a five-point scale (1 = almost never/never, 5 = almost always/always). For the purpose of the present study, only social anxiety (α = 0.83) and depression-coping (i.e., labeled as "coping motives" in the CMMQ; α = 0.85) motives were examined. Depression-coping motives assess coping with negative affect, with example items such as "Because you were depressed" and "To escape from your life." Example items of the social anxiety motives include "Because it makes you feel more comfortable in an unfamiliar situation" and "Because it relaxes you when you are in an insecure situation." Items for each motive were summed and averaged, with higher scores indicating more frequent endorsement of cannabis use for that motive.

*Social Anxiety.* The 20-item Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998) assessed social anxiety. Example items include "I have difficulty talking with other people" and "I worry about expressing myself in case I appear awkward." Participants rated the extent to which

they believed each item was characteristic or true of them on a five-point scale (0 = Not at all, 4 = extremely). Items were summed, with higher scores indicating greater social anxiety (α = 0.94).

*Data Analysis*

A fully saturated path model was evaluated using Mplus 8.6 (Muthén & Muthén, 1998-2017). We examined specific cannabis expectancies (i.e., relaxation and tension reduction, cognitive behavioral impairment , social and sexual facilitation) and motives (i.e., coping, social anxiety) as parallel mediators in a multiple mediation model: social anxiety symptoms → cannabis expectancies → cannabis motives → cannabis use → cannabis problems. All variables were standardized (i.e., z-scores) to produce standardized regression coefficients. We examined the total, direct, and indirect effects using bias-corrected bootstrapped estimates based on 10,000 bootstrapped samples. Given our large sample size and to reduce Type I error, statistical significance was determined based on 99% bias-corrected bootstrapped confidence intervals that did not contain zero.

## RESULTS

Descriptive statistics and bivariate correlations among all study variables are presented in Table 1. On average, participants reported 11.32 (*SD* = 10.67) weekly cannabis use blocks in the past month. Social anxiety symptoms ranged from 0-74, with most of the sample (69.1%) falling below the clinical cut-off for significant social anxiety (Brown et al., 1997). Social anxiety symptoms were positively significantly associated with all other study variables except cannabis use, and they were also associated with being assigned female at birth. Despite this finding, we opted to retain cannabis use as an outcome in the path model because prior work has found that social anxiety is not directly related to cannabis use, though it does have indirect effects (Single et al., 2022). Cannabis problems were positively significantly associated with all other study variables, as well as with being assigned male at birth. Finally, all expectancies and motives were significantly positively associated with one another.

Table 1. *Bivariate Correlations and Descriptive Statistics Among All Study Variables*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | *M* | *SD* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Sex[a] | --- | | | | | | | | | 0.72 | 0.45 |
| 2. SA Symptoms | **.14** | --- | | | | | | | | 27.44 | 14.04 |
| 3. RTR Expectancies | .06 | **.11** | --- | | | | | | | 3.57 | 0.86 |
| 4. SSF Expectancies | .01 | **.15** | **.63** | --- | | | | | | 3.10 | 0.64 |
| 5. CBI Expectancies | .03 | **.23** | **.18** | **.16** | --- | | | | | 3.14 | 0.78 |
| 6. SA Motives | -.01 | **.26** | **.43** | **.43** | **.11** | --- | | | | 2.22 | 1.18 |
| 7. Coping Motives | .03 | **.28** | **.36** | **.22** | **.24** | **.62** | --- | | | 2.31 | 1.21 |
| 8. Cannabis Use | -.09 | .05 | **.30** | **.22** | -.08 | **.32** | **.24** | --- | | 11.32 | 10.67 |
| 9. Cannabis Problems | **-.11** | **.15** | **.25** | **.16** | **.33** | **.31** | **.43** | **.44** | --- | 4.41 | 4.69 |

*Note.* [a] Sex was coded 0 = male, 1 = female. Significant correlations at $p < .001$ are in bold typeface for emphasis. SA = Social Anxiety; RTR = Relaxation/Tension Reduction; SSF = Social/Sexual Facilitation; CBI = Cognitive/Behavioral Impairment.

*Path Analysis*

We did not find evidence of significant direct effects from social anxiety symptoms to cannabis use or problems when accounting for all other variables in the model. However, several significant indirect effects of social anxiety symptoms on cannabis use and problems were supported. Regarding cannabis use, there were positive indirect effects of social anxiety symptoms through relaxation and tension reduction expectancies, β = 0.02, 99% CI [0.003, 0.05] and social anxiety motives, β = 0.04, 99% CI [0.01, 0.08] on cannabis use. Conversely, there was a negative indirect effect of social anxiety symptoms through cognitive behavioral

impairment expectancies on cannabis use, ß = -0.04, 99% CI [-0.07, -0.01]. Further, two serial mediation effects from social anxiety symptoms to cannabis use were indicated: social anxiety symptoms were positively associated with relaxation and tension reduction and social and sexual facilitation expectancies, which were positively associated with social anxiety motives, and in turn associated with increased cannabis use, both paths: ß = 0.01, 99% CI [0.001, 0.02].

Regarding cannabis problems, there were positive indirect effects from social anxiety symptoms via cognitive behavioral impairment expectancies, ß = 0.07, 99% CI [0.04, 0.11] and coping motives, ß = 0.06, 99% CI [0.03, 0.10]. In addition, social anxiety symptoms were positively associated with both relaxation and tension reduction and cognitive behavioral impairment expectancies, which in turn were associated with greater coping motives, which were associated with greater cannabis problems, relaxation and tension reduction: ß = 0.01, 99% CI [0.002, 0.03]; cognitive behavioral impairment: ß = 0.01, 99% CI [0.002, 0.02]. Next, social anxiety symptoms were positively associated with relaxation and tension reduction expectancies, which were associated with greater cannabis use, which was in turn associated with increased problems, ß = 0.01, 99% CI [0.001, 0.02]. Conversely, social anxiety symptoms were positively associated with cognitive behavioral impairment expectancies, which in turn were associated with reduced cannabis use, which was then associated with fewer cannabis problems, ß = -0.02, 99% CI [-0.03, -0.01]. In addition, there was a positive indirect effect of social anxiety symptoms on cannabis problems via a positive association between social anxiety motives and cannabis use, ß = 0.02, 99% CI [0.004, 0.03]. Finally, there were four serial indirect effects for the comprehensive model. Social anxiety symptoms were positively associated with relaxation and tension reduction and social and sexual facilitation expectancies, which were positively associated with social anxiety motives, which were then positively associated with cannabis use, and in turn associated with greater cannabis problems (social anxiety symptoms → relaxation and tension reduction/social and sexual facilitation expectancies → social anxiety motives → cannabis use → cannabis problems; relaxation and tension reduction: ß = 0.002, 99% CI [0.00, 0.01]; social and sexual facilitation: ß = 0.003, 99% CI [0.001, 0.01]). In addition, social anxiety symptoms were positively associated with relaxation and tension reduction and cognitive behavioral impairment expectancies, which were positively associated with coping motives, which were positively associated with cannabis use, and in turn was associated with greater cannabis problems (social anxiety symptoms → relaxation and tension reduction/cognitive behavioral impairment expectancies → coping motives → cannabis use → cannabis problems; both paths: ß = 0.001, 99% CI [0.00, 0.01]). The total and indirect effects for the path model are detailed in Table 2 and direct effects are shown in Figure 1.

Table 2 . *Summary of Total, Indirect, and Direct Effects of social anxiety Symptoms on Cannabis Problems via Cannabis Motives, Expectancies, and Cannabis Use*

| | *Cannabis Use* | | *Cannabis Problems* | |
|---|---|---|---|---|
| | ß | 99% CI | ß | 99% CI |
| Predictor: Social Anxiety Symptoms | | | | |
| Total | 0.05 | -0.05, 0.16 | **0.15** | **0.05, 0.24** |
| Total indirect[a] | **0.06** | **0.01, 0.12** | **0.16** | **0.09, 0.24** |
| RTR Expectancies | **0.02** | **0.00, 0.05** | 0.00 | -0.02, 0.01 |
| SSF Expectancies | 0.01 | -0.01, 0.03 | -0.01 | -0.03, 0.01 |
| CBI Expectancies | **-0.04** | **-0.07, -0.01** | **0.07** | **0.04, 0.11** |
| SA Motives | **0.04** | **0.01, 0.08** | -0.01 | -0.03, 0.02 |
| Coping Motives | 0.02 | -0.01, 0.05 | **0.06** | **0.03, 0.10** |
| Cannabis Use | | | -0.00 | -0.05, 0.04 |
| RTR Expectancies – SA Motives | **0.01** | **0.00, 0.02** | 0.00 | -0.01, 0.01 |
| SSF Expectancies – SA Motives | **0.01** | **0.00, 0.02** | 0.00 | -0.01, 0.01 |

| | | | | |
|---|---|---|---|---|
| CBI Expectancies – SA Motives | -0.00 | -0.01, 0.00 | 0.00 | -0.01, 0.01 |
| RTR Expectancies – Coping Motives | 0.00 | -0.00, 0.01 | **0.01** | **0.01, 0.03** |
| SSF Expectancies – Coping Motives | -0.00 | -0.01, 0.00 | -0.00 | -0.01, 0.01 |
| CBI Expectancies – Coping Motives | 0.00 | -0.00, 0.01 | **0.01** | **0.00, 0.02** |
| RTR Expectancies – Cannabis Use | | | **0.01** | **0.00, 0.02** |
| SSF Expectancies – Cannabis Use | | | 0.00 | -0.01, 0.01 |
| CBI Expectancies – Cannabis Use | | | **-0.02** | **-0.03, -0.01** |
| SA Motives – Cannabis Use | | | **0.02** | **0.00, 0.03** |
| Coping Motives – Cannabis Use | | | 0.01 | -0.00, 0.02 |
| RTR Expectancies – SA Motives – Cannabis Use | | | **0.00** | **0.00, 0.01** |
| SSF Expectancies – SA Motives – Cannabis Use | | | **0.00** | **0.00, 0.01** |
| CBI Expectancies – SA Motives – Cannabis Use | | | 0.00 | -0.00, 0.00 |
| RTR Expectancies – Coping Motives – Cannabis Use | | | **0.00** | **0.00, 0.01** |
| SSF Expectancies – Coping Motives – Cannabis Use | | | 0.00 | -0.00, 0.00 |
| CBI Expectancies – Coping Motives – Cannabis Use | | | **0.00** | **0.00, 0.00** |
| Direct | -0.01 | -0.11, 0.09 | -0.02 | -0.10, 0.07 |

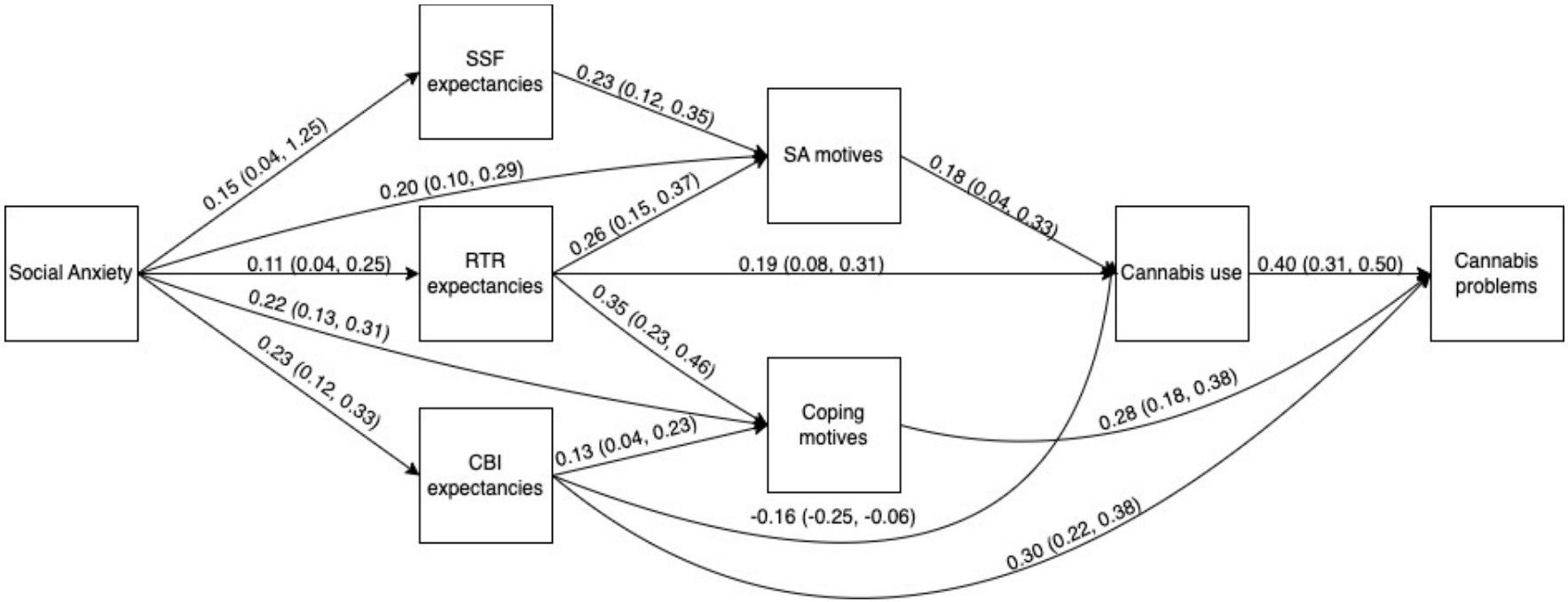
*Note.* Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. Significant confidence intervals that appear to include zero are the result of rounding and do not truly include zero. [a] Reflects the combined indirect associations within the model. RTR = Relaxation/Tension Reduction; SSF= Social/Sexual Facilitation; CBI = Cognitive/Behavioral Impairment; SA = Social Anxiety.

*Exploratory Sex Invariance Testing*

Given prior research demonstrating differences across study variables based on sex assigned at birth or gender, we performed an exploratory multi-group analysis to evaluate whether model associations were invariant based on sex assigned at birth. Specifically, $\chi^2$ difference tests were used to examine whether a freely estimated multi-group model differed as compared to a constrained multi-group model. Because the $\chi^2$ statistic is sensitive to sample size (Brown, 2015), invariance was determined at $p >$ .01, and decreases in CFI and TLI of greater than .01 from the freely estimated model (Putnick & Bornstein, 2016). Results from the fully constrained model indicated that this model was not invariant across sex assigned at birth due to a decrease of .011 in CFI and .022 in TLI compared to the freely estimated model. To identify an invariant model, we identified the path with the greatest contribution to reducing model fit within the fully constrained model. Once we identified the path and allowed for it to be freely estimated, we identified and freely estimated the next path with the greatest contribution at reducing model fit, repeating this procedure until we achieved acceptable model fit.

In the final multi-group model, $\chi^2$ (25) = 25.97, $p$ = .41; CFI = 1.0, TLI = 1.0, all associations were constrained between sex except for two paths: (a) the path between cognitive behavioral impairment expectancies and coping motives, and (b) the path between social and sexual facilitation expectancies and social anxiety motives. Further, the association between social and sexual facilitation and cognitive behavioral impairment expectancies was also unconstrained. The relation between cognitive behavioral impairment expectancies and coping motives was positive and significant for male students, ß = 0.24, 99% CI [0.10, 0.38], but not significant for females, ß = 0.09, 99% CI [-0.02, 0.19]. The relation between social and sexual facilitation expectancies and social anxiety motives was positive and significant for females, ß = 0.27, 99% CI [0.15, 0.38], yet non-significant for males, ß = 0.13, 99% CI [-0.03, 0.30]. Further, the relation between social and sexual facilitation and cognitive behavioral impairment expectancies was positive and significant for female students, ß = 0.19, 99% CI [0.08, 0.30], but not males, ß = -0.01, 99% CI [-0.17, 0.15]. Examination of indirect effects involving

Figure 1. *Path Model Depicting the Direct Effects of Social Anxiety and Cannabis-related Problems vis Cannabis Expectancies, Cannabis Motives, and Cannabis Use*




*Note*. Depicts the standardized effects of the path model predicting cannabis-related problems. Significant associations were determined by 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. Non-significant paths are not depicted for parsimony but are available upon request. SSF = social/sexual facilitation; RTR = relaxation and tension reduction; CBI = cognitive behavioral impairment; SA = social anxiety.

these pathways in the multigroup model indicated one indirect path that was significant in the original model that was not invariant by sex: social anxiety → cognitive behavioral impairment → coping motives → cannabis problems. This indirect effect was significant for male students, ß = 0.01, 99% CI [0.00, 0.02], but not female students, ß = 0.01, 99% CI [-0.002, 0.01]. All other significant indirect effects identified in the overall model were invariant across sex assigned at birth.

## DISCUSSION

Informed by the motivational model (Cox & Klinger, 1988), the current study tested a path model of the relation between social anxiety and cannabis use and problems through coping-related expectancies and motives among a sample of past-month undergraduate cannabis users. Replicating prior work (Single et al., 2022), social anxiety was not significantly directly related to cannabis use, though it was positively associated with cannabis problems. This finding suggests that college students high in social anxiety may not be vulnerable to using cannabis more frequently than their peers who are lower in social anxiety; however, they may be at a heightened risk for experiencing cannabis problems. Despite a significant bivariate correlation, there was not a significant direct association between social anxiety and cannabis problems after including relevant expectancies and motives into the path model, suggesting that the relation between social anxiety and cannabis problems may be explained by these cognitions. We did find significant direct effects in the path model between social anxiety and all included expectancies and motives, providing support for their relevance to social anxiety as coping-related cognitions. In addition, there were unique indirect and direct effects depending on type of expectancies and motives endorsed, highlighting the necessity of using a theory-informed model of coping-related cannabis cognitions to understand the relation between social anxiety and cannabis problems.

Consistent with our hypothesis, there was a positive indirect association between social anxiety and cannabis problems through cognitive behavioral impairment expectancies, depression coping motives, and cannabis use. This is consistent with previous research showing that cognitive behavioral impairment expectancies and coping motives independently mediate the positive relation between social anxiety and cannabis problems (Buckner & Schmidt, 2008; Buckner et al., 2007). This indirect effect was similarly significant when cannabis use was the outcome in our model. It is possible that cannabis-related cognitive and behavioral impairment may be desirable among individuals who are high in social anxiety, especially when they believe that the impairment will help them cope with their depression symptoms, which increases cannabis use and risk for problems. Interestingly, there was a positive indirect association between social anxiety and cannabis problems through cognitive and behavioral impairment expectancies, but this effect was negative when cannabis use was the outcome in our model. Given that the measure of cannabis problems used in the current study is comprised of some items that reflect delayed problems such as, "When using marijuana I have done impulsive things that I have later regretted" and "I have become very rude, obnoxious, or insulting after using marijuana," it is possible that individuals who are high in social anxiety report greater cannabis consequences because they ruminate on the actions that they made while they were cognitively and behaviorally impaired from cannabis, resulting in greater self-report of problems later in time despite not having used frequently. Notably, there was no direct effect between, nor a significant indirect effect involving, cognitive behavioral impairment expectancies and social anxiety motives, as hypothesized. As such, it is possible that students high in social anxiety who endorse strong cognitive behavioral impairment expectancies may not use cannabis to cope with their symptoms of social anxiety because they either do not expect that the impairment from cannabis will assist with concerns over negative evaluation, or they are concerned that the impairment may exacerbate negative evaluation.

Also consistent with our hypotheses, we found a positive indirect effect from social anxiety to cannabis problems that ran through social and sexual facilitation expectancies and social anxiety coping motives. Similarly, this indirect effect remained significant when cannabis use was examined as the outcome variable. Students high in social anxiety may expect cannabis to make them more sociable and/or sexual, which in turn motivates them to use cannabis to alleviate their

social anxiety symptoms. For example, college students high in social anxiety may use cannabis to help them better fit into their social environments and consequently draw less attention to themselves, which could reduce potential fears of being negatively evaluated. Importantly, social and sexual facilitation expectancies were only related to social anxiety motives, and not depression coping motives. College students high in social anxiety may be motivated to use cannabis to cope with their social anxiety symptoms because they expect that cannabis will directly lower their social anxiety symptoms by making them feel more confident, comfortable, and social, but this expectation does not extend to being motivated to use cannabis to improve depression symptoms. Further, social and sexual facilitation expectancies do appear to align well with social anxiety motives, given that both reference cognitions pertaining to social interactions, whereas depression coping motives reference negative affect more broadly (e.g., "To forget your problems").

We further hypothesized that social anxiety would indirectly positively relate to cannabis problems via relaxation and tension reduction expectancies, social anxiety motives, and increased cannabis use. While this hypothesis was supported, we *also* found a positive indirect effect from social anxiety to cannabis problems that ran through relaxation and tension reduction expectancies, depression coping motives, and cannabis use. Similarly, paths through relaxation and tension reduction expectancies and both types of motives remained significant when cannabis use was examined as the outcome. College students who are high in social anxiety may expect cannabis to reduce their anxious tension, which in turn motivates them to use cannabis to cope more broadly with their negative affect. In other words, it does not appear that college students who are high in social anxiety who endorse strong relaxation and tension reduction expectancies are only motivated to use cannabis to cope with their symptoms relating to depression or anxiety, but instead they may be using cannabis to cope more broadly. This finding may be understood by considering the negative affectivity characterized by both symptoms of depression and anxiety. Given that relaxation and tension reduction expectancies involve anticipation of reduced tension and increased relaxation, it is not surprising that college students who are high in social anxiety may find the potential tension/relaxation effects of cannabis to be desirable and a means of managing the negative emotional states that they experience from both their symptoms of depression and social anxiety.

Overall, results from this study highlight the necessity of using a comprehensive model of cannabis cognitions to understand the relation between social anxiety symptoms and cannabis consequences. That is, inclusion of cognitive factors (i.e., expectancies and motives) outlined in motivational models of cannabis use (Cox & Klinger, 1998) elucidate nuanced pathways that can be used to understand these relations and identify at-risk users. For example, the finding that there was a negative indirect relation between social anxiety symptoms and cannabis problems via increased cognitive behavioral impairment expectancies and reduced cannabis use, but a positive indirect relation when coping motives were added to the model, suggests that specific combinations of expectancies and motives may alter relations between social anxiety and cannabis problems. In turn, our findings suggest that those with increased relaxation and tension reduction or social sexual facilitation expectancies *and* increased social anxiety motives, as well as those with increased relaxation and tensions reduction or cognitive behavioral impairment expectancies *and* coping motives maintain the most risk for cannabis problems when social anxiety is present. In sum, individuals with social anxiety may use cannabis to alleviate distressing social anxiety and depression-relevant symptoms, but then may be prone to increased risk of negative consequences due to greater cannabis use. Accordingly, these combinations of expectancies and motives warrant further investigation as possible risk factors and consequent targets for treatment.

As an exploratory aim, we tested model invariance across sex assigned at birth, given that prior research has found sex/gender differences with both cannabis use and social anxiety. We found two direct paths that differed by sex. First, we found that the relation between cognitive behavioral impairment expectancies and depression coping motives was significant for individuals assigned male at birth, but not females. Male college students, especially those

high in social anxiety, may endorse the belief that cannabis-related impairment will help them cope with their depression symptoms more strongly than female college students. In addition, we found that the link between social and sexual facilitation expectancies and social anxiety motives was only significant for college students who were assigned female at birth, indicating that female students may be motivated to use cannabis to cope with social anxiety symptoms because they believe that cannabis will help make them feel more social/sexual. Given that males reported greater cognitive behavioral impairment expectancies than females, it is possible that females expect cannabis to help facilitate their social interactions more strongly because they do not believe that they will be too impaired to carry out social/sexual interactions, whereas males may believe the opposite. When examining invariance across indirect paths, we found that the indirect path between social anxiety and cannabis problems through cognitive behavioral impairment expectancies and depression coping motives, which was significant in the overall model, was not invariant, such that it was only significant for male students. Interestingly, there was only a sex difference when cannabis use was not included in the model. This finding may suggest that male college students who endorse strong cognitive behavioral impairment expectancies and coping motives experience greater cannabis problems than college student females, but not necessarily because they are using cannabis at greater frequencies. It may instead be that male students experience greater cannabis-related problems because they consume their cannabis differently than females and males who do not have strong cognitive behavioral impairment expectancies and coping motives. For example, they may combine their cannabis with other substances (e.g., alcohol) or use in greater quantities, and therefore experience greater cannabis-related problems, despite not necessarily consuming cannabis at greater frequencies. On the whole, nearly all paths in our model were sex-invariant, indicating that the general relations between social anxiety and cannabis problems through coping-related expectancies and motives function in similar ways for both male and female college students.

Results from the current study importantly highlight the necessity of using a comprehensive model of cannabis cognitions to understand the relation between social anxiety and cannabis problems; however, there are several limitations to consider. First, our cross-sectional study design precludes our ability to make causal inferences. Thus, future work using longitudinal or momentary study designs is needed to increase confidence in the present findings. Second, the current study used the original version of the SIAS, which uses the item "I have difficulty talking to attractive persons of the opposite sex." This item introduces biases for sexual and gender minority individuals, who may systematically respond differently to this item due to their perceptions of sexual attraction. Therefore, future studies may consider using a modified version of this item, such as "I have difficulty talking to attractive persons" to be more inclusive to gender and sexual minority individuals (Rahm-Knigge et al., 2018). Although an important strength in our study is our diverse and multisite sample, our results are most specific to college students who were assigned female sex at birth and are enrolled in psychology courses. As such, future research is needed to examine the applicability of these findings across broader and more diverse undergraduate samples. Our model also did not include information on quantity or type (e.g., edibles vs. concentrates) of cannabis use, which may uniquely relate with the variables included in this study and should be examined in future research. Lastly, our sample was not restricted to individuals who have clinically significant social anxiety symptoms. Applying this research to a clinical sample is a necessary next step.

Despite these limitations, the current study is the first to utilize a theory-informed motivational model of coping-related cannabis cognitions to examine the relation between social anxiety and cannabis problems in a sample of college student cannabis users, including attending to assessing type of cannabis coping motive separately. Findings highlight the necessity of differentiating coping motives into motives to cope with depressed mood and motives to cope with social anxiety in order to better understand the relation between social anxiety and cannabis problem. As such, additional research is needed to examine the relation between social anxiety and cannabis problems using Lee and colleagues' (2009) better-specified coping motives. In addition, findings from this study may be used to inform

intervention efforts designed to reduce cannabis-related harm among college students who are high in social anxiety. Given that expectancies are potentially modifiable and can be challenged through expectancy challenge paradigms (e.g., Darkes & Goldman, 1993), intervention efforts may focus on modifying cognitive behavioral impairment, relaxation and tension reduction, and social and sexual facilitation expectancies. In addition, college students high in social anxiety may benefit from interventions focused on identifying alternative means of coping with depression and social anxiety symptoms outside of cannabis use. Given that there was a direct effect between social anxiety and cannabis problems, it is possible that targeting social anxiety directly may be efficacious in reducing cannabis-related problems among college students who are high in social anxiety. Specifically, individuals who are high in social anxiety may benefit from receiving either a full course of Cognitive Behavioral Therapy (CBT) or an intervention that encompasses key components of CBT, such as exposure tasks, as CBT is considered the gold-standard treatment for social anxiety disorder (Tolin, 2010). Taken together, utilizing theory-driven approaches to understanding relations between social anxiety, coping-related cannabis cognitions, and cannabis outcomes may help inform interventions among populations at higher risk for negative cannabis-related consequences.

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