Solitary Cannabis Use Frequency Mediates the Relationship Between Social Anxiety and Cannabis Use and Related Problems

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Abstract

Background and Objectives—Individuals with elevated social anxiety are seven times more likely to meet criteria for cannabis use disorders, yet social anxiety is unrelated to more frequent cannabis use. The lack of relation to cannabis use frequency may be at least partially due to lack of attention to cannabis use context. It may be that socially anxious persons engage in frequent solitary cannabis use, perhaps using before social situations in the hope that being intoxicated during the social event will help them feel less anxious. In fact, using cannabis alone has been associated with experiencing more cannabis-related problems in prior work.

Methods—The current study sought to identify whether solitary cannabis use frequency mediated the relationship between social anxiety and cannabis-related problems among 276 current cannabis using undergraduates who completed an online survey of putative predictors of substance use.

Results—Social anxiety was robustly related to more frequent solitary (but not social) cannabis use and solitary cannabis use frequency uniquely mediated the relation of social anxiety to cannabis use and related problems.

Discussion and Conclusions—Frequent solitary use appears to play an important role in the experience of cannabis-related problems among socially anxious persons.

Scientific Significance—Intervention strategies may benefit from targeting frequent solitary cannabis use, particularly among at-risk users such as those with elevated social anxiety.

INTRODUCTION

Chronic cannabis use and cannabis use disorders (CUD) are associated with high rates of comorbidity with anxiety disorders.[1–3] Social anxiety is one type of anxiety that seems particularly related to cannabis problems. Nearly one-third to one-fourth of people with cannabis dependence have social anxiety disorder (SAD), a higher rate than for panic

disorder, generalized anxiety disorder, and post-traumatic stress disorder.[4,5] Accumulating data suggest social anxiety may be a risk factor for the development of cannabis-related problems. Among those with SAD and CUD, SAD tends to onset prior to the CUD.[6] Among adolescent cannabis users, SAD is related to transition from first use to cannabis-related problems among males even after adjusting for delinquency.[7] Compared to adolescents without SAD, those with SAD were nearly seven times more likely to develop cannabis dependence in early adulthood.[8] Further, other anxiety disorders are not significantly prospectively related to subsequent CUD onset after adjusting for co-occurring disorders and/or other substance use.[8] Notably, elevated social anxiety in non-clinical samples also is related to more cannabis-related problems.[9–16] The relation between CUD and anxiety remains relatively stable and eventually requires treatment more often than CUD alone.[3]

Despite evidence of a robust and potentially unique relation between social anxiety and cannabis-related problems, social anxiety tends to be unrelated to frequency of cannabis use.[7–16] These puzzling data may be at least partially due to failure to account for context of use. Substance use tends to vary by context.[17–19] In our clinic, socially anxious patients have reported staying at home and smoking cannabis to avoid going to social events. Some research partially supports this clinical observation. Socially anxious individuals tend to avoid social situations if cannabis is unavailable[13] and social avoidance is robustly related to cannabis related problems.[10,20] Additionally, behavioral avoidance mediates the relation between social anxiety and coping-motivated cannabis use.[21] Solitary use of cannabis has been positively associated with cannabis-related problems, including CUD,[22–24] and solitary cannabis use in adolescence is prospectively associated with greater likelihood of experiencing illicit drug-related problems in early adulthood, even after controlling for quantity and frequency of use.[22] It has been theorized that solitary substance use is risky because during solitary use, people do not have the ability to compare their use to their peers' use.[25] In fact, social anxiety is positively related to solitary pre-drinking (ie, drinking before going to a social event) and is negatively related to social pre-drinking.[26] Solitary pre-drinking mediated the relation of social anxiety with alcohol-related problems. This corpus of research suggests that using cannabis alone may be one mechanism by which social anxiety is related to cannabis related problems.

The current study sought to elucidate the role of cannabis use context on the relation between social anxiety and cannabis-related problems in several ways. First, we tested the hypothesis that social anxiety would be related to more frequent solitary cannabis use. Second, we tested the hypothesis that social anxiety's relation with frequency of solitary cannabis use would be robust and remain after controlling for gender, negative affect more generally, and drinking frequency, given that these variables tend to be related to solitary substance use (eg, refs.[19,24,27]). Third, we tested the hypothesis that frequency of solitary cannabis use would mediate the relation of social anxiety to cannabis outcomes. These hypotheses were tested in an undergraduate sample in light of data suggesting that college students experience greater cannabis-related problems than their same-age, non-college peers.[28] Further, social anxiety appears to increase among youth transitioning from high school to college,[29] and several studies have shown elevated social anxiety to be related to cannabis-related problems among undergraduates.[9,12–14,16]

METHODS

Participants and Procedures

Participants were recruited through the psychology participant pool at a large state university in the southern United States for a study on college substance use. The university's Institutional Review Board approved the study and all participants provided informed consent prior to data collection. The consent form explained that participants' names would not be linked to their responses, assuring confidentiality of responses. Further, the consent form detailed that a certificate of confidentiality was obtained from the National Institute on Drug Abuse to further protect confidentiality. Participants completed computerized self-report measures using a secure, on-line data collection website (surveymonkey.com). All participants received referrals to university-affiliated psychological outpatient clinics and research credit for completion of the survey.

Of the 1,009 students who completed the survey, 278 endorsed past three-month cannabis use. Of those, two were excluded due to questionable validity of responses (described below). Thus, the final sample consisted of 276 (79.7% female) participants with a mean age of 20.2 (SD =2.0). The racial/ethnic composition was 12.0% non-Hispanic African American, .4% Hispanic African American, 1.0% American Indian or Alaska Native, 2.5% Asian or Asian American, 76.1% Non-Hispanic White, 2.2% Hispanic White, 4.7% multiracial, and 1.1% "other."

Measures

The Marijuana Use Form (MUF[9]) assessed cannabis use frequency in the past 3 months on a scale ranging from 0 (never) to 10 (21 or more times each week). The MUF has shown convergent validity with ecological momentary assessments of cannabis use.[30]

Social versus solitary cannabis use was assessed using items adapted from Gonzalez and Skewes[19] such that participants reported how many days during a typical month in the past year they used marijuana (1) in a social setting (ie, with others) and (2) while alone.

The Marijuana Problems Scale (MPS[31]) assessed 19 cannabis-related problems (eg, procrastination, lower productivity, memory loss) experienced in the past 90 days on a scale ranging from 0 (no problem) to 2 (serious problem). Number of problems was calculated by totaling the number of problems participants endorsed. The measure has achieved good internal consistency in prior work using this scoring strategy.[32,33] Internal consistency was good in the current sample (a =.77).

The Social Interaction Anxiety Scale (SIAS[34]) is a 20-item self-report scale that assessed trait social anxiety. Participants indicate the degree to which they believe each statement (eg, "I worry about expressing myself in case I appear awkward") is characteristic or true of them on a scale ranging from 0 (not at all) to 4 (extremely). The SIAS has shown adequate internal consistency in prior work among undergraduate cannabis users[33] and specificity for social anxiety relative to other forms of anxiety (ie, trait anxiety).[35] Internal consistency was excellent in the current sample (a =.94).

The Negative Affect subscale of the Positive and Negative Affect Scale (PANAS[36]) was used to assess trait negative affect. This subscale is comprised of 10 emotions. Participants rate the extent to which they generally experience (ie, "how you feel on average") each of the listed emotions from 1 (very slightly or not at all) to 5 (extremely). The PANAS is a widely used and well-validated measure (for review see ref.[37]). Internal consistency was good in the current sample (a =.87).

The Daily Drinking Questionnaire (DDQ[38]) assessed past-month typical weekly drinking frequency from 0 (I did not drink at all) to 6 (once a day or more). The DDQ has demonstrated good convergent validity[38] and test-retest reliability.[39]

The Infrequency Scale (IS[40]) was used to identify random responders who provided random or grossly invalid responses. Four questions (eg, "I find that I often walk with a limp, which is the result of a skydiving accident") from the IS were included. As in prior online studies,[41] individuals who endorsed three or more infrequency items were excluded from this study (n =2).

Data Analytic Strategy

First, bivariate correlations among study variables were examined to test whether social anxiety was related to frequency of solitary cannabis use. Second, a hierarchical linear regression was conducted to examine whether social anxiety remained related to frequency of solitary use after controlling for gender, negative affect, and past-month drinking frequency. Covariates were entered at Step 1 and social anxiety was entered at Step 2 to ensure that an effect at Step 2 cannot be attributed to variance shared with variables in Step 1.[42] Third, we tested whether cannabis use contexts mediated the relations of social anxiety to cannabis use and related problems using maximum likelihood bootstrapping (10,000 samples were drawn) within the structural equation modeling program AMOS 22 (Fig. 1). Effects of social anxiety on cannabis use contexts and from use contexts to cannabis outcomes represent unique associations after controlling for shared variance. Model fit were calculated via chi-square, Comparative Fit Index (CFI), and Standardized Root Mean Square Residual (SRMR). A non-significant chi-square indicates good model fit; however, chi-square is sensitive to sample size. A CFI value of .95 or higher and an SRMR value of .08 or lower are indicative of good model fit.[43] Covariances were estimated among cannabis use contexts and among cannabis outcomes to control for shared variance. Mediation is present if the indirect effect CI does not contain zero.[44]

RESULTS

Means, standard deviations, and bivariate correlations among study variables appear in Table 1. Social anxiety was significantly correlated with number of cannabis problems and frequency of solitary (but not social) cannabis use, although the effect sizes were small. As evidenced in Table 2, covariates (gender, negative affect, drinking frequency) accounted for 4.6% of the variance in frequency of solitary cannabis use and social anxiety accounted for an additional 3.3% of the variance.

The hypothesized model (Fig. 1) was a good fit to the data, $\chi^2(2) = 4.46$, $p = .108$, CFI=1.00, RMSEA=.07. As hypothesized, social anxiety was significantly, positively related to solitary cannabis use frequency. Social anxiety was not significantly related to social cannabis use frequency. Both cannabis use contexts were significantly associated with cannabis outcomes. The paths between context and cannabis use frequency, $b = .056$, SE =.040, 90% CI = −.011, .120, $p = .164$, and problems, $b = −.061$, SE =.049, 90% CI=−.142, .017, $p = .209$, were not significantly different. Social anxiety was indirectly (via solitary use frequency) related to cannabis use frequency, $b = .092$, SE=.038, 90% CI=.037, .161, $p = .003$, and cannabis-related problems, $b = .023$, SE =.018, 90% CI =.002, .063, $p = .051$.

DISCUSSION AND CONCLUSIONS

The current study adds to a growing body of work delineating a strong relationship between social anxiety and cannabis-related problems by identifying a potential mechanism through which social anxiety influences cannabis-related problems. The current study replicated prior work finding that social anxiety is positively associated with cannabis-related problems.[7–16] Also consistent with prior work,[22–24] solitary cannabis use was related to more cannabis-related problems.

Prior work was extended by determining that social anxiety was incrementally related to more frequent solitary (but not social) cannabis use. This finding is especially important when considered in light of our mediational finding that solitary use frequency mediated the relation of social anxiety to cannabis use and cannabis-related problems. This finding is in line with prior work finding that socially anxious cannabis users tend to avoid social situations if cannabis is unavailable[13] as well as the finding that social avoidance is robustly related to cannabis related problems.[10,20] It may be that more socially avoidant individuals engage in frequent solitary cannabis use rather than attending social events. Alternatively, it may be that some socially anxious persons use cannabis prior to social events to manage anticipatory anxiety about the event and/or use cannabis following the social event to manage negative affectivity associated with post-event processing, in which socially anxious persons tend to review a social event, focusing on negative aspects of their performance during the event.[45] An important next step in this line of research will be to identify the circumstances in which socially anxious persons engage in solitary use.

Although not the primary aims of the study, two other findings warrant comment. First, the effect size regarding the correlation between social anxiety and cannabis problems was small. However, there is growing consensus that an association between two variables is not a precondition for mediation.[44] Further, in light of data indicating that youth with elevated social anxiety are nearly seven times more likely to develop cannabis dependence by age 30,[8] effects that are statistically small in magnitude may have important clinical significance.[46] In this case, the finding that social anxiety exerts its influence on cannabis problems indirectly via more frequent solitary use may inform efforts to improve treatment and prevention interventions for this high-risk group. Second, consistent with prior work,[7–16] there was no significant direct effect of social anxiety with cannabis use frequency. There was, however, a significant indirect effect through solitary cannabis use. This suggests that social anxiety exerts its influence on cannabis use frequency generally

indirectly via more frequent solitary use. The lack of significant direct effect observed so consistently in the literature[47] may reflect that other factors also mediate this relationship, but in a protective fashion. For instance, it may be that socially anxious individuals who engage in more social activities (ie, are less socially avoidant) do not use cannabis frequently for fear of behaving in ways while under the influence that may be negatively evaluated by others. Future work aimed at further understanding factors that influence the frequency of cannabis use in various contexts among socially anxious persons will be an important next step in identify high-risk situations for these vulnerable individuals.

SCIENTIFIC SIGNIFICANCE

Findings have important clinical implications. For instance, given the strong relation between solitary use and cannabis-related problems, clinicians may consider assessing for whether patients undergoing CUD treatment engage in solitary cannabis use and if so, teach patients skills to decrease such risky use. Such skills may be particularly beneficial to patients with elevated social anxiety, especially given that anxious patients have poorer CUD treatment outcomes.[48] Given that social anxiety was related to more frequent solitary use, these patients may benefit from the integration of cognitive behavioral skills[49] to help them more adaptively manage their social anxiety. Also, given that reductions in anxiety are prospectively related to better CUD treatment outcomes,[48] clinicians may consider assessing for and targeting social anxiety in the context of CUD treatment.

The results of the current study should also be interpreted in light of limitations. First, the sample is comprised relatively culturally homogenous undergraduates (ages 18–29; 76.1% Non-Hispanic White). Additional work is necessary to test whether results generalize to more diverse samples of cannabis users. Further, men tend to report more solitary cannabis use[24] and more social avoidance than women[10]; thus, future work with larger samples of men will be an important next step to test whether gender moderates the observed findings. Second, the methods of the current study were cross-sectional in nature, limiting our ability to test causation. Studies of anxiety disorders generally (eg, ref.[3]) and social anxiety specifically (eg, ref.[8]) suggest that social anxiety may be a risk factor for the development of CUD. Our results suggest that one mechanism via which this may occur is solitary use. Thus, future prospective work is necessary to delineate causal relations as well as to investigate whether greater cannabis-related problems occurs among socially anxious persons as a result of lack of social comparisons of peers' cannabis use during solitary use (per[25]) or via other mechanisms, such as smoking to cope with loneliness or other negative affective states given that coping motives are robustly related to cannabis-related problems[50] and are endorsed more by heavy solitary drinkers compared to heavy social drinkers.[19] Third, data were retrospective self-report and future work could benefit from multimethod (eg, ecological assessment of use situations, biological verification of use) and multi-informant (eg, collateral reports of frequency of social use) approaches. Fourth, future work may consider assessing quantity or perceived intoxication in addition to frequency of cannabis use.

Despite the limitations, the current study adds to a growing corpus of work finding solitary cannabis use to be a risky context for cannabis use. Further, results indicate that social

anxiety is related to more frequent solitary use and that frequency of solitary use mediates the relation of social anxiety to more frequent cannabis use generally as well as more cannabis-related problems. Together, these data suggest that social anxiety and solitary use may be important targets in cannabis use prevention and treatment efforts.

Acknowledgments

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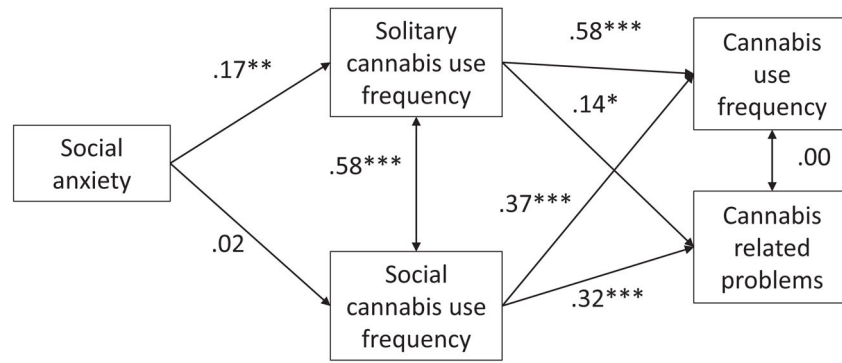
FIGURE 1.

Structural equation model for cannabis use contexts mediating the relation of social anxiety to cannabis outcomes. Standardized path estimates are presented. Paths between use contexts and between cannabis outcomes are covariances. *p<.05, **p<.01, ***p<.001.

TABLE 1

Bivariate correlations among study variables

	1	2	3	4	5	6	7	8
Social anxiety								
# Cannabis problems	.14*							
Cannabis use frequency	.09	.34**						
Social use frequency	.02	.41**	.70**					
Solitary use frequency	.17**	.33**	.79**	.57**				
Negative affect	.40**	.07	−.02	−.07	.06			
Drinking frequency	.03	.06	−.13*	−.01	−.12*	−.06		
Gender	.07	−.16**	−.16**	−.13*	−.18**	−.03	.08	
M (SD)	19.7 (11.2)	2.3 (2.6)	3.0 (2.6)	7.4 (7.9)	4.4 (8.5)	19.1 (6.3)	2.4 (1.3)	

Social anxiety was assessed with the Social Interaction Anxiety Scale (SIAS[34]), number of cannabis problems with the Marijuana Problems Scale (MPS[31]), and negative affect with the Negative Affect subscale of the Positive and Negative Affect Scale (PANAS[36]). Gender was dummy coded (0, male; 1, female).

*
$p < .05$,

**
$p < .01$.

TABLE 2

Incremental relationship of social anxiety to days during a typical month in the past year that they engaged in solitary cannabis use

	R^2	F	β	t	p	sr^2
Step 1	.046	4.42			.005	
Gender			−.17	−2.84	.005	.03
Negative affect			.05	.87	.387	.00
Drinking frequency			−.11	−1.8	.072	.01
Step 2	.033	9.74			.002	
Social anxiety			.20	3.12	.002	.03

Social anxiety was assessed with the Social Interaction Anxiety Scale (SIAS[34]) and negative affect with the Negative Affect subscale of the Positive and Negative Affect Scale (PANAS[36]). Gender was dummy coded (0, male; 1, female). β, standardized beta coefficient.