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Cannabis-Related Problems and Social Anxiety: The Mediation Role of Post-Event Processing

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Abstract

Background: Cannabis is the most commonly used illicit drug in the US, and is associated with a range of psychological, social, and physical health-related problems. Individuals who endorse elevated levels of social anxiety are especially at risk for experiencing cannabis-related problems, including cannabis use disorder, despite not using cannabis more often than those with more normative social anxiety. Identification of mechanisms that underlie the relationship between social anxiety and cannabis-related problems may inform treatment and prevention efforts. Post-event processing (PEP; i.e., cognitively reviewing past social interactions/performances) is a social anxiety-related phenomenon that may be one such mechanism.

Objectives: The current study sought to test PEP as a mediator of the relationship between social anxiety and cannabis-related problems, adjusting for cannabis use frequency.

Method: Cannabis-using (past three-month) undergraduate students recruited in 2015 ($N = 244$; 76.2% female; 74.2% Non-Hispanic Caucasian) completed an online survey of cannabis use, cannabis-related problems, social anxiety, and PEP.

Results: Bootstrap estimate of the indirect effect of social anxiety through PEP was significant, suggesting PEP is a mediator of the social anxiety – cannabis-related problems relationship.

Conclusions/Importance: Treatment and prevention efforts may benefit from targeting PEP among individuals with elevated social anxiety and cannabis-related problems.

Keywords

cannabis; social anxiety; post-event processing; college students; cannabis-related problems

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Cannabis is the most commonly used illicit drug in the United States (Substance Abuse and Mental Health Services Administration, 2014b). Additionally, it is the illicit drug with the highest rate of disorder (Substance Abuse and Mental Health Services Administration, 2014a). Undergraduates are at particular risk for cannabis use and related problems, as nearly half of undergraduates report that they have used cannabis (Mohler-Kuo, Lee, & Wechsler, 2003). High rates of use are concerning given that approximately two-thirds of cannabis-using undergraduates reported at least one cannabis-related problem, with the most common problems concerning academic functioning (procrastination, lower energy, less productivity, memory loss, missing work or school; Buckner, Ecker, & Cohen, 2010). College students are also at risk for experiencing cannabis-related problems other than those related to academic performance. One-half of college student cannabis users report that they drove a vehicle after using cannabis (McCarthy, Lynch, & Pederson, 2007), and driving under the influence of cannabis is positively related to risk of crashing (Ramaekers, Berghaus, van Laar, & Drummer, 2004), including fatal crashes (Bédard, Dubois, & Weaver, 2007). Given the high rates of cannabis use combined with the high rate of cannabis-related problems, it is important to identify factors that place individuals at risk for experiencing cannabis-related problems to inform prevention and treatment efforts.

Social Anxiety as a Risk for Cannabis Use Disorder

Social anxiety has shown a strong link to the development of cannabis related problems, including cannabis use disorder (CUD). Adolescents with social anxiety disorder (SAD) are seven times more likely than those without SAD to meet criteria for CUD in early adulthood (Buckner et al., 2008). Further, individuals who meet diagnostic criteria for co-occurring SAD and CUD report the onset of SAD symptoms prior to CUD (Buckner et al., 2012). Among cannabis-using men, social anxiety was related to faster development of cannabis-related problems, including CUD, after first use of cannabis (Buckner et al., 2012; Marmorstein, White, Loeber, & Stouthamer-Loeber, 2010). Social anxiety is also uniquely related to cannabis problems among the anxiety disorders, as higher rates of SAD are observed among individuals with CUD (approximately 25%) compared to other anxiety disorders, including panic disorder and generalized anxiety disorder (Agosti, Nunes, & Levin, 2002; Stinson, Ruan, Pickering, & Grant, 2006). Further, SAD in adolescence is related to the development of CUD in early adulthood, but this temporal relationship is not observed for other disorders, including depressive disorders and other anxiety disorders, speaking to the potential specificity of SAD as a risk factor for CUD (Buckner et al., 2008).

Despite the clear links between elevated social anxiety and cannabis-related impairment, the majority of work has shown social anxiety to be unrelated to cannabis use frequency (e.g., Buckner, Bonn-Miller, Zvolensky, & Schmidt, 2007; Buckner et al., 2010; Buckner et al., 2008; Ecker & Buckner, 2014; Ecker, Richter, & Buckner, 2014). Accumulating evidence suggests that greater social anxiety is associated with greater more cannabis-related problems despite not also being related to greater cannabis use frequency (e.g., Buckner et al., 2007; Buckner & Schmidt, 2009; Ecker & Buckner, 2014; Ecker et al., 2014; Marmorstein et al., 2010). Socially anxious individuals appear to be at increased risk for experiencing cannabis-related problems despite not using cannabis more frequently than

non-socially anxious individuals, suggesting that something about the way they use may place them at risk for problems.

Socially anxious cannabis users are especially vulnerable to use cannabis to cope with negative affect (e.g., Buckner, Zvolensky, & Schmidt, 2012) or to avoid unpleasant experiences (e.g., Buckner, Zvolensky, Farris, & Hogan, 2014), and using to cope mediates the relationship between social anxiety and cannabis-related problems (Buckner et al., 2007). Yet, socially anxious persons do not use cannabis more frequently is not related to more cannabis use in social situations; rather it is related to more solitary cannabis use (Buckner, Ecker, & Dean, 2016). In fact, more frequent solitary use mediated the relation between social anxiety and use-related problems. It is therefore important to identify factors that may be related to solitary cannabis use, especially among socially anxious users.

Post-Event Processing

Post-event processing (PEP) may be one form of especially salient negative cognition that increases the likelihood that socially anxious persons will continue to use cannabis despite related problems. According to cognitive models of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997), in addition to experiencing anxiety during or in anticipation of social stimuli, socially anxious individuals may also review past interactions in great detail, with a focus on perceived negative performance or others' negative reactions (for review see Brozovich & Heimberg, 2008). Individuals who endorse greater social anxiety are more likely to report experiencing PEP than those endorsing less social anxiety (Brozovich & Heimberg, 2013; Field & Morgan, 2004; Kocovski & Rector, 2007; Perini, Abbott, & Rapee, 2006; Rachman, Grüter-Andrew, & Shafran, 2000). Importantly, PEP is specific to social situations among individuals with elevated social anxiety such that fear of negative evaluation (but not other feared stimuli; e.g., spiders/insects) was positively related to PEP (Fehm, Schneider, & Hoyer, 2007). PEP tends to be more prevalent and more negatively valenced among socially anxious individuals than among non-socially anxious individuals (for review see Brozovich & Heimberg, 2008).

Very few studies have examined the role of PEP in the relationship between social anxiety and substance use and substance-related problems. One study tested PEP's relationship to alcohol use among a sample of undergraduates (Battista & Kocovski, 2010). More alcohol use during a social situation was related to more PEP after a recent social event, even when controlling for depression and social performance anxiety. However, no known studies have tested whether PEP is related to substance-related problems. Solitary cannabis use is related to more use and more cannabis-related problems among those with greater social anxiety, and more frequent solitary use is related to greater number of cannabis-related problems (Buckner, Ecker, & Dean, 2016). It may be that although socially anxious individuals do not use more cannabis generally, they are more likely to use alone which may be in part due to managing negative affect from PEP.

Study Aims and Hypotheses

The current study's primary aim was to fill gaps in the literature by examining the role of PEP in the relationship of social anxiety to use and related problems. In light of theoretical rationale described above for PEP as a potential mechanism underlying the social anxiety-cannabis-related problems relationship, it was hypothesized that PEP would mediate the relationship between social anxiety and cannabis-related problems.

Method

Participants and Procedures

Participants were 244 current (past three months) cannabis-using undergraduates recruited through the University's psychology participant pool to complete an online study using www.surveymonkey.com, a secure, online data-collection site. Participants provided informed consent and participants received research credit for their psychology courses for participating. Of the 445 students who consented to participate in the study, 152 were deemed ineligible at screening due to being under the age of 18 ($n = 1$) and denying past three-month cannabis use at screening ($n = 151$). Of the 293 eligible participants who started the survey, 244 completed all assessments. The ethnic/ racial composition was 13.5% African American/Black, 5.7% Asian, 0.8% American Indian, 74.2% non-Hispanic Caucasian, 1.2% Hispanic Caucasian, and 5.0% multiracial. The sample was 76.2% women. The study was approved by the University's Institutional Review Board prior to data collection, and a Certificate of Confidentiality was obtained from the National Institutes of Health to further ensure confidentiality.

Measures

Screening

Participants were first asked if they have used cannabis in the past three months. Cannabis use was assessed for the past three months given that is the timeframe used in measures of cannabis-related problems (e.g., Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition; American Psychiatric Association, 2013; Marijuana Problems Scale [MPS]; Stephens, Roffman, & Curtin, 2000). Participants were also asked to report their age.

Study Measures

A self-report version of the *Timeline Follow Back* (TLFB; Sobell, Brown, Leo, & Sobell, 1996) assessed past-week cannabis use at baseline. Participants were asked to report the number of cannabis cigarettes (i.e., "joints") used on each day in the past seven days. Computer-administered versions of the TLFB have shown good test-retest reliability (Sobell et al., 1996).

The *Marijuana Problems Scale* (MPS; Stephens et al., 2000) was used to assess cannabis-related problem severity. The MPS consists of 19 items that reflect negative consequences related to cannabis use in the past three months. Participants rated each problem from 0 (*no problem*) to 2 (*serious problem*). The MPS has achieved good internal consistency in prior work (Lozano, Stephens, & Roffman, 2006) and in the current study ($\alpha = 0.89$).

Social anxiety was assessed with the *Social Interaction Anxiety Scale* (SIAS; Mattick & Clarke, 1998). The SIAS is a 20-item self-report measure of interaction fears. Participants rated how true each item is of them on a scale from 0 (*not at all*) to 4 (*extremely*). The SIAS has demonstrated construct and discriminant validity (Mattick & Clarke, 1998), as well as test-retest reliability across clinical, community, and student samples (Mattick & Clarke, 1998; Osman, Gutierrez, Barrios, Kopper, & Chiros, 1998). It has also demonstrated good internal consistency among undergraduate cannabis users (e.g., Ecker & Buckner, 2014) and in the current study ($\alpha = 0.89$).

The *Post-Event Processing Questionnaire* (PEPQ; Rachman et al., 2000) was used to assess tendency for post-event processing after a social event. Participants rated 13 items on a scale from 0 (*not at all*) to 100 (*very much*). The PEPQ has achieved good internal consistency in prior work (Rachman et al., 2000) and was excellent in the current sample ($\alpha = 0.95$).

Data Analytic Strategy

Mediation was tested using bootstrapping, which is robust to deviations from normality (Hayes, 2013) using the PROCESS macro for SPSS (IBM Corp, 2013), which uses an ordinary least squares-based path analysis to test direct and indirect effects (Hayes, 2013). The indirect effect was tested with bias-corrected bootstrap estimates (10,000 samples) that were used to construct 95% confidence intervals (CIs).

Results

Means, standard deviations, and correlations between study variables are presented in Table 1. Social anxiety was significantly, positively associated with cannabis-related problem severity, but not cannabis use frequency. PEP was significantly, positively associated with social anxiety. Interestingly, PEP was also significantly, positively associated with cannabis-related problem severity (but not cannabis use).

Regarding mediation, the total effects model accounted for significant variance, $R^2 = 0.17$, $df = 2,241$, $F = 25.89$, $p < .001$, as did the full model with PEP included, $R^2 = 0.22$, $df = 3,240$, $F = 23.01$, $p < .001$. The direct effect of social anxiety when controlling for PEP remained significant, $B = 0.08$, $SE = 0.02$, $p < .001$. The indirect effect was estimated and was significant, $B = 0.03$, bootstrap $SE = 0.01$, 95% CI: 0.02, 0.05, suggesting that social anxiety is related to cannabis-related problems indirectly through tendency to engage in PEP (Figure 1).

Discussion

First, the current study replicated a growing body of work that has found greater social anxiety to be related to greater cannabis-related impairment (e.g., Agosti et al., 2002; Buckner, Heimberg, et al., 2012; Buckner et al., 2008; Stinson et al., 2006), despite not being related to greater typical cannabis use (e.g., Buckner et al., 2007; Ecker & Buckner, 2014; Ecker et al., 2014). The current study extended that work by finding that tendency to engage in PEP was positively associated with cannabis-related problem severity, but not cannabis use frequency, and that PEP mediated the relationship between social anxiety and

cannabis-related problem severity. Given that individuals with clinical levels of social anxiety are especially prone to engage in PEP (Fehm, Hoyer, Schneider, Lindemann, & Klusmann, 2008; Kocovski, Endler, Rector, & Flett, 2005), PEP's relation to cannabis-related problem severity in the current study highlights PEP as a social anxiety-related construct that may be a mechanism through which social anxious persons develop more severe cannabis-related problems. Further, the current study adds to scant literature on the role of PEP in substance use as the first known study of the effect of PEP on cannabis use and related problem severity.

In light of the finding of the current study supporting PEP as a mechanism through which social anxiety impacts cannabis-related problems, treatment approaches that address PEP may be useful to integrate into interventions that address co-occurring social anxiety and cannabis-related problems. Although no known treatments target PEP specifically, PEP has been found to be malleable during psychosocial interventions. First, although the treatment does not target PEP specifically, group cognitive behavior therapy (CBT) for social anxiety has been shown to reduce PEP among individuals with SAD, which was in turn related to reductions in symptoms of SAD (Hedman et al., 2013). Further, distraction after a social event has been shown to reduce both engagement in PEP and distress related to PEP (Blackie & Kocovski, 2015) and socially anxious individuals who engaged in mindfulness following a laboratory-based negative PEP induction reported more positive affect compared to individuals in a control condition (Cassin & Rector, 2011). These findings highlight the ability to reduce PEP's impact on social anxiety through psychosocial interventions, and the potential utility of therapeutic techniques that directly address PEP.

Integrated treatments of co-occurring anxiety and cannabis use disorders are a growing area of work that show some promise for the simultaneous treatment of both disorders (e.g., Buckner, Ecker, Beighley, et al., 2016). It may be that integration of strategies that aim to reduce PEP such as cognitive restructuring or mindfulness may be targets of such integrated treatments among individuals with co-occurring CUD and social anxiety. Further, given that tendency to engage in PEP was related to greater endorsement of cannabis-related problem severity, such treatment approaches (e.g., cognitive restructuring of PEP) may also be beneficial in treatment approaches that address CUD more broadly (i.e., among CUD patients regardless of level of social anxiety).

Limitations/Future Directions

The current study's findings must be considered in light of the study's limitations. First, the sample was comprised entirely of a relatively racially/ethnically homogenous student sample. However, college students remain a population especially at risk for cannabis use and related problems (e.g., Buckner et al., 2010; Mohler-Kuo et al., 2003). Future work may benefit from recruitment of a more diverse sample to determine if these results are generalizable to other populations. Second, this study was cross-sectional in design. Future work is necessary to test whether socially anxious persons use cannabis more while engaging in PEP which in turn increases their risk for cannabis-related problems. Relatedly, an important next step in this line of research will be to directly assess whether socially anxious persons use cannabis to manage negative affect associated with PEP. Third, the

study relied on self-report measures. Future work may benefit from a multi-method approach (e.g., biological verification of cannabis use, experimentally-induced PEP, more naturalistic designs such as ecological momentary assessment of PEP and cannabis use). Fourth, given that the current study was conducted with a non-clinical sample and future work will be necessary to test whether observed results generalize to those with more clinically elevated social anxiety and/or cannabis-related problems.

Conclusions

Despite these limitations, this study identified a cognitive vulnerability (PEP) related to cannabis use problem severity and furthered understanding of the relation of social anxiety and cannabis problems by finding that PEP mediated this relation. Thus, PEP may be an especially important target of cognitive restructuring among CUD patients generally and among individuals with co-occurring social anxiety and cannabis-related problems specifically. Findings highlight the importance of continued efforts to identify cognitive vulnerabilities underlying the relationship between social anxiety and cannabis problems to ultimately improve prevention and treatment efforts.

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Figure 1.

Mediation models for the relationships among conformity motives, cannabis refusal self-efficacy, and cannabis-related problem severity. Unstandardized path coefficients are presented. Indirect effect and associated standard error is presented below the mediator. * $p < .05$, *** $p < .001$

Table 1:

Means, Standard Deviations, and Correlations of Study Variables

	<i>M</i>	<i>SD</i>	1	2	3	4
1. Age	20.32	1.70	-			
2. Past Week Cannabis Use Frequency	2.56	5.20	.15 [*]	-		
3. Cannabis-Related Problem Severity	3.68	4.59	.03	.28 ^{**}	-	
4. Social Anxiety	20.33	12.67	.01	.07	.32 ^{**}	-
5. Post-Event Processing	40.50	25.92	-.06	.08	.34 ^{**}	.33 ^{**}

*
 $p < 0.05$ **
 $p < 0.01$