2016

The Impact of Experimentally Manipulated Post-Event Processing on the Relationship between Social Anxiety and Cannabis Craving and Use

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THE IMPACT OF EXPERIMENTALLY MANIPULATED POST-EVENT PROCESSING ON THE RELATIONSHIP BETWEEN SOCIAL ANXIETY AND CANNABIS CRAVING AND USE

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Psychology

by
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B.S., Louisiana State University, 2009
M.A., Louisiana State University, 2013
August 2016

For Laura

ACKNOWLEDGEMENTS

Thank you to my family (Mom, Dad, Jacob, Lynn, Grant, Merritt, Michael, and Ryan) and friends, especially (but certainly not limited to and in no particular order!) John Blanchard, Jessica Kinsaul, Tracey Auster, Steve Proctor, Christine Vinci, Gustavo Douaihi, Russell and Ana Nolan, Chris DeBosier, Matt Yglesias, and Aaron Cherry. Thanks also to my great lab mates/friends who make Audubon Hall a much more fun place. Thank you to the research assistants in the lab whose work contributed to the success of this project. Thank you to my internship cohort, internship supervisors, and research collaborators at VA Connecticut Healthcare System and Yale School of Medicine. Thank you to my dissertation committee, Dr. Julia Buckner, Dr. Alex Cohen, Dr. Tyler Renshaw, and Dr. Elaine Maccio for their thoughtful review and support of this project. Thank you to Dr. Julia Buckner for your mentorship throughout several stages of my academic career. Thank you for your consistent guidance and thoughtful feedback that has prepared me for the steps that lie ahead. Finally, thank you Laura, without your constant support, encouragement, and sense of adventure this document would not be possible.

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ABSTRACT

Cannabis-related problems are major public health concerns. Social anxiety appears to be a unique risk factor that contributes to the development of cannabis-related problems, including cannabis use disorders. Given this risk, identification of cognitive vulnerabilities that may contribute to the onset and maintenance of co-occurring social anxiety and cannabis-related problems remains an important research goal. Socially anxious individuals experience anxiety and negative affect in response to cognitively reviewing past social situations (i.e., post-event processing [PEP]) and are likely to use cannabis to cope with negative affective states, which may occur during PEP. Thus, PEP may be one cognitive vulnerability factor that contributes to the onset and maintenance of cannabis use and related problems. The current study sought to identify the influence of PEP on cannabis craving and use. Current (past three-month) cannabis-using undergraduates (N = 158) completed an online battery of self-report measures and were randomized to one of three conditions: (1) negative PEP, (2) positive PEP, or (3) control task. Participants provided ratings of cannabis craving before and after the task and completed measures of cannabis use one week later to examine if experimentally manipulated PEP influenced cannabis use and cannabis-related problem severity. Experimentally induced PEP was not related to subsequent cannabis craving, use, or use-related problems one week later, nor did PEP interact with social anxiety to predict cannabis outcomes at follow-up. However, at baseline, PEP mediated the relationship between social anxiety and cannabis-related problem severity, suggesting that the tendency to engage in PEP is a mechanism through which social anxiety influences cannabis-related problems. PEP may be a target of treatment and prevention efforts that address co-occurring social anxiety and cannabis-related problems.

INTRODUCTION

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), and approximately 25% of undergraduate cannabis users meet criteria for cannabis use disorder (CUD; Caldeira, Arria, O'Grady, Vincent, & Wish, 2008). Cannabis use among undergraduates is associated with a range of problems that can negatively impact performance in college, including lower grades (Bell, Wechsler, & Johnston, 1997; Buckner, Ecker, & Cohen, 2010; Goode, 1971), difficulty concentrating, sleeping in class (Caldeira et al., 2008), difficulties with memory (Kouri, Pope, Yurgelun-Todd, & Gruber, 1995; Shillington & Clapp, 2001), and performing poorly on tests (Shillington & Clapp, 2001). Further, college students are 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 impairment associated with cannabis-related problems, it is important to identify factors that place individuals at risk for experiencing cannabis-related problems to potentially inform prevention and treatment.

Social Anxiety as a Risk for Cannabis Use Disorders

Social anxiety has shown a strong link to the development of cannabis related problems, including 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). 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, very little work suggests that more frequent cannabis use may be related to greater social anxiety (Oyefeso, 1991). 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). Socially anxious individuals may be at increased risk for experiencing cannabis-related problems despite not using cannabis more frequently than non-socially anxious individuals.

Several additional findings further speak to the clinical importance of co-occurring social anxiety and cannabis. Among frequent cannabis users, elevated social anxiety is related to greater suicidality (Buckner, Joiner, Schmidt, & Zvolensky, 2012). Further, individuals with elevated anxiety who are undergoing treatment for CUD evince poorer treatment outcomes than

those with less anxiety (Buckner & Carroll, 2010). Given the clinical significance of co-occurring social anxiety and cannabis-related impairment, identification of cognitive vulnerability factors that contribute to the etiology and maintenance of these co-occurring conditions could improve treatment and prevention efforts.

Post-Event Processing

Given that socially anxious cannabis users may be 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), it may be that one form of especially salient negative cognition is post-event processing (PEP). According to cognitive models of social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997), socially anxious individuals do not experience anxiety only when in anticipation of or during social situations. Rather, 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). Empirical evidence has supported this model of PEP, suggesting that 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). After a social stressor, socially anxious participants were more likely to engage in PEP than those with less social anxiety, especially if they believed their performance was poor or they were given feedback that their performance was poor (Perini et al., 2006; Zou & Abbott, 2012). Importantly, PEP is specific to social situations among individuals with elevated social anxiety such that fear of negative evaluation was positively related to PEP, but not other feared stimuli (e.g., spiders/insects; Fehm, Schneider, & Hoyer, 2007).

Not only are socially anxious individuals engaging in PEP, but PEP tends to be negative in nature (Kocovski, Endler, Rector, & Flett, 2005). Further, PEP tends to center around how the situation could have been different or "what might have been" (i.e., counterfactual; Kocovski et al., 2005) and such counterfactual thoughts are positively associated with negative affect (Roese & Olson, 1993). 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). PEP may serve as a cognitive vulnerability for cannabis use and related problems among socially anxious individuals.

In an experimental manipulation of PEP, participants were randomized to a negative PEP task (i.e., recall negative memories of a social event), positive PEP task (i.e., recall positive memories of a social event), or neutral task (Field & Morgan, 2004). Greater social anxiety was related to experiencing more negative and shameful memories regardless of PEP type (i.e., both negative and positive PEP conditions) compared to those in a reading control condition in which they did not engage in any PEP. This finding may be due in part to self-verification, such that individuals tend to process information or seek feedback from others in a manner consistent with their extant self-views (Swann, 2012). That is, socially anxious individuals may support their negative self-view (Rapee & Heimberg, 1997) by discounting positive information or highlighting information supporting their negative self-view. In support of this hypothesis, negative feedback-seeking (an indicator of tendency for negative self-verification) is positively related to trait social anxiety (Valentiner, Skowronski, McGrath, Smith, & Renner, 2011). Thus, being instructed to focus on positive aspects of one's performance may increase distress among socially anxious persons. Supporting this notion, individuals with elevated social anxiety tended to experience greater state anxiety after receiving positive feedback than non-socially anxious

individuals (Budnick, Kowal, & Santuzzi, 2014). Interestingly, participants with greater social anxiety reported that negative memories experienced during a negative PEP task were more calming than anxiety-provoking (Field & Morgan, 2004), speaking to the reinforcing effects of PEP in socially anxious individuals (Brozovich & Heimberg, 2008), which is consistent with self-verification theory. Further, in one study, trait social anxiety was negatively related to preferences for positive and negative feedback, suggesting that socially anxious individuals may prefer to receive no feedback, whether positive or negative (Weeks, Jakatdar, & Heimberg, 2010). More work is necessary to determine if self-verification potentially explains the phenomenon that socially anxious individuals may experience anxiety in response to positive PEP.

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 who rated their alcohol use and degree to which they engaged in PEP after a recent social event they experienced (Battista & Kocovski, 2010). More alcohol use during a social situation was related to more PEP after the situation, even when controlling for depression and social performance anxiety. It may be that socially anxious individuals experience more PEP following a social event in which they consumed alcohol because they believed that their negative performance due to their alcohol use. However, this study did not assess if PEP was related to subsequent alcohol use. It is currently unclear how PEP relates to substance use or related problems among socially anxious individuals. Among undergraduates with clinically elevated social anxiety, men (but not women) who consumed more alcohol during a social situation in the laboratory reported more PEP over a four-day period following the social situation (Battista, Pencer, & Stewart, 2014). Further, PEP mediated

the relationship between social anxiety and alcohol-related problems (Buckner, Terlecki, & Ecker, 2014). Taken together, these findings suggest that PEP may be a key cognitive factor underlying the relationship between social anxiety and substance-related problems.

In sum, it may be that socially anxious individuals use cannabis to cope with negative affect experienced during PEP. However, it remains unknown if PEP is related to greater desire to use cannabis. Testing cannabis craving in response to PEP may be an important first step in delineating the role of PEP among socially anxious cannabis users.

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 cannabis craving and use. First, in light of data suggesting that individuals experience heightened cannabis craving in response to social anxiety-provoking tasks (e.g., Buckner, Ecker, & Vinci, 2013), the current study sought to test the hypothesis that experimentally manipulated negative PEP would be related to greater cannabis craving compared to positive PEP and a control condition (i.e., no PEP), while controlling for trait social anxiety, depression, and anxiety more broadly. Second, in light of data suggesting that PEP is positively related to negative affect (Kashdan & Roberts, 2007) and cannabis use is more likely after situations involving negative affect (e.g., Buckner, Zvolensky, & Ecker, 2013), it was predicted that negative PEP would be related to more frequent cannabis use and more severe cannabis-related problems at one-week follow-up compared to positive PEP and a control condition (i.e., no PEP), controlling for trait social anxiety, depression, anxiety more broadly, and baseline cannabis use. Baseline cannabis-related problems were also included as a covariate when follow-up cannabis problems were the dependent variable. Third, it was hypothesized that the current study would extend prior work (Field & Morgan, 2004) by finding that PEP condition

would moderate the relationship between social anxiety and post-task state anxiety such that social anxiety would be positively correlated with post-task state anxiety in both the negative and positive PEP tasks, but not in the control task, even after controlling for pre-task state anxiety. Fourth, given that individuals with elevated trait social anxiety experience cannabis craving in response to social-anxiety provoking tasks (Buckner, Silgado, & Schmidt, 2011), it was hypothesized that condition (i.e., negative vs. control, positive vs. control, and negative vs. positive) would interact with social anxiety to predict cannabis craving such that social anxiety would be positively related to post-task cannabis craving among participants in the negative condition (but not control or positive when compared to those conditions, respectively) and positive condition (when compared to the control condition). Fifth, if trait social anxiety predicted post-task craving in the PEP conditions, it was hypothesized that PEP (i.e., both positive and negative) would mediate the relationship between social anxiety and post-task cannabis craving.

Sixth, it was expected that if PEP influenced cannabis craving, it would also influence actual cannabis use. Specifically, given that the majority of work does not observe a direct relationship between trait social anxiety and cannabis use frequency (e.g., Buckner et al., 2007; Buckner et al., 2010; Buckner et al., 2008; Ecker & Buckner, 2014; Ecker et al., 2014), it was hypothesized that both types of PEP would moderate the relationship between trait social anxiety and follow-up cannabis use frequency, such that among participants in the PEP conditions (but not among participants in the control condition), greater social anxiety would be related to more frequent follow-up cannabis use.

A secondary aim of the proposed study was to better understand why positive PEP is distressing to those with elevated social anxiety (Field & Morgan, 2004). In line with self-

verification theory (Swann, 1983; Weeks et al., 2010), it was hypothesized that negative feedback-seeking, an indicator of tendency for negative self-verification (Swann, Wenzlaff, Krull, & Pelham, 1992), would mediate the relationship between trait social anxiety and post-task state anxiety among individuals engaging in positive PEP.

METHOD

Participants

Participants were 158 current (past three months) cannabis-using undergraduates recruited through the University's psychology participant pool. Of the 372 students who signed up to participate, eight did not consent to participate in the study. Of the remaining 364 participants, 131 were deemed ineligible at screening due to being under the age of 18 (n = 2) and denying past three-month cannabis use at screening (n = 129). Of the 233 eligible participants who started the baseline survey, 201 completed all baseline assessments and were invited to complete follow-up. Of those 201, 158 (78.6%) completed follow-up and thus were included in the current study. Completers did not significantly differ from non-completers on age, F (1,199) = 0.12, p = .732, η^2 = 0.00, race/ethnicity, χ^2 (6, N = 201) = 5.20, p = .519, φ = 0.16, or gender χ^2 (1, N = 201) = 1.78, p = .311, φ = 0.08. Completers also did not differ from non-completers on social anxiety, F (1,199) = 1.18, p = .278, η^2 = 0.08, cannabis use frequency, F (1,199) = 0.01, p = .934, η^2 = 0.00, pre-task craving, F (1,199) = 0.18, p = .669, η^2 = 0.00, pre-task state anxiety, F (1,199) = 0.93, p = .336, η^2 = 0.00, post-task craving, F (1,199) = 0.25, p = .618, η^2 = 0.00, post-task state anxiety F (1,199) = 0.16, p = .688, η^2 = 0.00, and post-event processing, F (1,199) = 1.72, p = .191, η^2 = 0.01. The final sample of completers was primarily Caucasian non-Hispanic and female (Table 1).

Measures

Screening. The first two questions of the baseline survey assessed eligibility. Participants completed the *Marijuana Use Form* (MUF; Buckner et al., 2007) to ensure current (i.e., past three month) cannabis use. Participants were asked to rate their cannabis use on a scale ranging from 0 (*never*) to 6 (*once or more every day*). 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). This measure has shown good convergent validity with ecological momentary assessments of cannabis use (Buckner, Crosby, Wonderlich, & Schmidt, 2012). Participants were also asked to report their age.

Baseline. 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). Participants were also asked when their last use of cannabis occurred to assess whether participants may have been under the influence when completing the experiment.

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 on a scale from 0 (*no problem*) to 2 *(serious problem*). The MPS has achieved good internal consistency in prior work (Lozano, Stephens, & Roffman, 2006). At baseline, the MPS evidenced good internal consistency in the current study ($\alpha = 0.89$).

Social anxiety was assessed at baseline 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 21-item version of the *Depression Anxiety Stress Scale* (DASS-21; Antony, Bieling, Cox, Enns, & Swinson, 1998) was used to control for baseline depression and anxiety more broadly to isolate the effects of social anxiety on cannabis craving and use after the task. Participants rated the degree to which they experienced each item in the past week on a 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*) scale. Item scores were summed to create a total score in which higher scores reflect greater depression/anxiety. Subscales specific for depression and anxiety can be obtained by summing the items reflecting the specific constructs. The depression and anxiety scales of the DASS-21 have achieved adequate levels of internal consistency in samples of substance-using college students (Buckner, Ecker, & Proctor, 2011). Further, the DASS has shown convergent validity with other measures of depression and anxiety (Antony et al., 1998). In the current sample, internal consistency was excellent for the depression subscale ($\alpha = 0.90$), and good for the anxiety subscale ($\alpha = 0.82$).

The *Feedback-Seeking Questionnaire-Social Subscale-Dimensional Format* (FSQ-SS-DF; Weeks et al., 2010) was used to assess negative self-verification. The FSQ-SS-DF consists of 18 self-referent questions (e.g., "Why would it be hard to develop a warm friendship with [*your name here*]") in which participants rated the degree to which they would want someone close to them to respond to each question on a 0 (*I would strongly prefer that they not answer this sort of question about me*) to 4 (*I would strongly prefer that they answer this question about me*) scale. Nine questions reflected positive feedback-seeking, and nine questions reflected negative feedback-seeking. Items for each subscale were totaled and higher scores on each

subscale reflected stronger preference for positive and negative feedback, respectively. The negative subscale was used to measure negative feedback-seeking. The subscales of the FSQ-SS-DF have achieved good internal consistency and construct validity has been supported in prior work (Weeks et al., 2010). Internal consistency of the negative subscale in the current sample was excellent ($\alpha = 0.97$).

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). Internal consistency in the current sample was excellent ($\alpha = 0.95$).

Task assessments. Cannabis craving before and after the PEP induction was assessed using a visual analog scale (VAS; M. S. Hayes & Patterson, 1921) on which participants indicated how much they were craving cannabis in the moment on a 0 (*no urge*) to 100 (*extreme urge*) scale. VAS scales of cannabis craving positively correlate with longer measures of cannabis craving (Buckner, Silgado, & Schmidt, 2011). State anxiety was assessed before and after the task using the *Subjective Units of Distress Scale* (SUDS; Wolpe, 1968). Participants rated their state anxiety on a scale ranging from 0 (*totally relaxed, on the verge of sleep*) to 10 (*the highest anxiety you have ever experienced*). This scale is positively correlated with longer measures of state anxiety among cannabis users (Buckner, Crosby, et al., 2012). This measure was used in a manipulation check to determine if state anxiety differed after the task between conditions.

To further induce PEP during the task, participants were asked two questions adapted from items on the *Post-Event Processing Questionnaire* (PEPQ; Fehm, Hoyer, Schneider,

Lindemann, & Klusmann, 2008). These questions were administered to ensure that participants engaged in PEP. These questions asked participants to think about specific aspects of their behavior during the event they described in their writing task. The questions were adapted from the PEPQ and tailored to match the valence of the assigned task. Specifically, participants in the negative PEP condition were asked to rate how negatively they believed their behavior and attributes were from 0 (*not at all*) to 100 (*very strong*), and participants in the positive PEP condition were asked how positively they believed their behavior was on a similar scale. Participants also rated an additional item adapted from the PEPQ and tailored to condition: (a) "As you thought about the event, did your feelings about the event worsen" (if in the negative condition), and (b) "As you thought about the event, did your feelings about the event improve" (if in the positive condition). Participants in the neutral condition completed two items adapted from the PEPQ that were more neutrally worded, ranging from 0 (*not at all*) to 100 (*always, very strong*) how much they thought of the event after it was over, and if the event was difficult to forget. These items were neutrally worded (i.e., do not include if their thoughts improved/worsened) to avoid inducing negative or positive thoughts about the topic they described in the control task.

Follow-up. Follow-up occurred one week after baseline. A one-week TLFB was administered to assess past-week cannabis use frequency. A one-week version of the MPS was administered to assess past-week cannabis-related problem severity. Internal consistency was acceptable at follow-up ($\alpha = 0.73$).

Experimental Conditions

Participants were randomly assigned to one of three conditions, adapted from Field and Morgan (2004). In each condition, participants were asked to think of a social event in the past

week. In the negative PEP condition (n = 55), participants were instructed to describe in detail a recent social event, with a focus on the negative aspects of their performance or other's reactions to them during the event. In the positive PEP condition (n = 54), participants were asked to describe a recent social situation, focusing on positive aspects of their performance or others' reactions to them during the event. In the control condition (n = 49), participants were asked to write about a topic about which they learned in class in the past week. In all conditions, participants were asked to write at least 10 lines of text describing what they were thinking and respond to questions adapted from the PEPQ to ensure adequate engagement in the task. Before and after the task, participants rated their level of cannabis craving and state anxiety.

Procedures

Participants completed the battery of measures and their task (negative PEP, positive PEP, or control) on www.surveymonkey.com, a secure, online data-collection site. Participants first provided informed consent to participate in the study and to be contacted to complete follow-up. Participants' eligibility was confirmed with the MUF and an item confirming their age. The survey ended after these two questions for ineligible participants.

Eligible participants completed baseline measures (i.e., cannabis use, social anxiety, depression and general anxiety, PEP, feedback-seeking, state cannabis craving, and state anxiety). Participants were then randomized to one of three conditions (a negative PEP condition, a positive PEP condition, and a control group) and then began their assigned task. Participants completed post-task measures of state cannabis craving and state anxiety upon completion of the task. Participants were informed that they would be sent an email one week after completion of baseline to complete brief follow-up measures. After completion of the follow-up measures, the participants were provided a written debriefing of the study and provided their compensation of

research credit points. All participants received referrals to campus-affiliated alcohol, drug, and mental health treatment upon completion of the study.

Data collected online, once downloaded, were stored on a secure server in Dr. Buckner's research laboratory in 110 Audubon Hall on LSU's campus. Participants' responses were identified only by an identification number. Participant tracking information (i.e., name and email) were stored and maintained in a password-protected file on password-protected computers in a locked laboratory. A Certificate of Confidentiality was obtained from the National Institutes of Health to further ensure confidentiality.

Data Analytic Strategy

First, potential differences between conditions on relevant variables (i.e., age, gender, race/ethnicity, and pre-task cannabis craving, state anxiety, trait social anxiety, PEPQ score, and past-three-month cannabis use frequency) were examined with analysis of variance (ANOVA) for continuous dependent variables (e.g., age, pre-task craving, pre-task state anxiety) and chi-square analyses for categorical dependent variables (i.e., gender, race/ethnicity). Any variables that were significantly different between the conditions were included as covariates in the subsequent analyses. Second, the experimental task's effect on state anxiety (i.e., manipulation check) was conducted using an ANOVA with condition as the independent variable and post-task state anxiety as the dependent variable. In light of prior work suggesting that PEP is positively related to state anxiety (McEvoy & Kingsep, 2006) it was hypothesized that participants in the negative PEP task would report the greatest state anxiety immediately after the task. Pair-wise differences between all three conditions were tested with post-hoc Tukey tests. Additionally, modified PEPQ questions administered during the task to enhance task participation were evaluated to observe the degree to which participants participated in PEP.

Hypotheses 1 and 2, that the negative PEP condition would be related to greater post-task cannabis craving, follow-up cannabis use, and severity of follow-up cannabis-related problems compared to the positive PEP and control conditions were tested using three analyses of covariance (ANCOVA), with task condition as the independent variable, post-task craving, follow-up cannabis use, or follow-up cannabis-related problems as the dependent variable, and trait social anxiety, depression, general anxiety, and pre-task state anxiety as covariates. Also, pre-task craving was included as a covariate for the model testing post-task craving, baseline past-week cannabis use was included as a covariate for the model testing follow-up cannabis use, and baseline cannabis-related problems was included as a covariate for the model testing cannabis-related problems as a dependent variable. Sum of squares type 3 for ANCOVA in SPSS version 22 (IBM Corp, 2013) was used because it is robust to differences in sample size in experimental designs (Tabachnick & Fidell, 2007). Post-hoc Tukey tests for multiple comparisons were used to test pair wise differences between all conditions.

Hypothesis 3, that trait social anxiety would interact with condition such that social anxiety would be positively related to post-task state anxiety in the PEP conditions (but not the control condition), was tested with three hierarchical linear regression models. Separate models were conducted for each interaction combination (i.e., three separate dummy coded variables such that negative PEP = 1 and control condition = 0, positive PEP = 1 and control condition = 0, and negative PEP = 1 and positive PEP = 0). Continuous predictor variables were centered in all moderation analyses to address multicollinearity. The covariate (i.e., baseline state anxiety) was entered at Step 1. Main effects of trait social anxiety and condition were entered at Step 2. The interaction between trait social anxiety and one of the three dummy-coded condition variables (i.e., social anxiety X negative PEP vs. control condition, social anxiety X positive PEP vs.

control condition, and social anxiety X negative PEP vs. positive PEP) was entered at Step 3 to ensure that variance attributed to the interactions is not attributable to any other steps (Cohen & Cohen, 1983). Regression with dichotomous independent variables is robust to differences in sample size (West, Aiken, & Krull, 1996).

Hypothesis 4, that trait social anxiety would be positively related to post-task cannabis craving in the PEP conditions, was tested with three hierarchical linear regressions similar to Hypothesis 3, with covariates of baseline cannabis craving, baseline cannabis use, depression, and general anxiety entered at Step 1. Main effects of social anxiety and condition variable were entered at Step 2. A dummy coding procedure identical to Hypothesis 3 was used. The interaction between social anxiety and the condition variable was entered at Step 3.

Hypothesis 5, that both types of PEP would mediate the relationship between social anxiety and post-task cannabis craving, was tested with a series of hierarchical multiple regressions per criteria set by Kenny, Kashy, and Bolger (1998). Two regression models were tested: the first testing negative PEP as mediator (i.e., dummy coded such that negative PEP = 1 and control condition = 0) and the second testing positive PEP as a mediator (positive PEP = 1 and control condition = 0). The covariates (i.e., baseline cannabis craving, cannabis use, depression, anxiety) were entered at Step 1 of each regression. Criterion 1 of mediation, that social anxiety would be related to post-task craving, was tested with hierarchical linear regression with covariates in Step 1 and social anxiety in step 2. Criterion 2 of mediation, that social anxiety would be related to condition, was tested with hierarchical logistic regression, with condition as the dependent variable, covariates entered at Step 1, and social anxiety entered in Step 2. To test the third criterion of mediation, the effect of condition on post-task craving after controlling for social anxiety was tested using hierarchical linear regression with covariates in

step 1, social anxiety in step 2, and condition in step 3. Hierarchical linear regression was used to test Criterion 4, which is to establish that PEP accounts for a substantial amount of variance in the relationship between social anxiety and post-task craving. Covariates were entered in step 1, condition in step 2, and social anxiety in step 3. If this regression equation is non-significant (i.e., $p > 0.05$) in conjunction with significant effects observed in Criteria 1-3, a partial mediation effect is supported (Kenny et al., 1998).

Hypothesis 6, that condition would moderate the relationship between trait social anxiety and follow-up cannabis use such that trait social anxiety would be positively related to follow-up cannabis use among participants in both PEP conditions (but not the control condition), was tested with three hierarchical multiple regression models. The first one tested negative PEP vs. control as a moderator, the second tested positive PEP vs. control as a moderator, and the third tested negative PEP vs. positive PEP as a moderator. The covariates (i.e., baseline cannabis use, depression, anxiety) were entered at Step 1. Main effects of social anxiety and condition (dummy coded such that the PEP condition being tested as a moderator = 1 and control condition = 0) were entered at Step 2. The interaction between social anxiety and condition was entered at Step 3 to ensure that variance attributed to the interaction was not attributable to any other steps (Cohen & Cohen, 1983). Significant interactions were probed by graphing the regression lines as per Cohen and Cohen (1983) and testing simple slopes as per Aiken and West (1991).

To test the secondary aim's hypothesis that negative feedback-seeking would mediate the relationship between trait social anxiety and post-task state anxiety among individuals engaging in positive PEP, a procedure similar to Hypothesis 5 utilizing a series of multiple regressions was followed. This analysis was conducted only among participants in the positive PEP condition. Pre-task state anxiety was included as a covariate in Step 1 of the regression models.

A Priori Power Analyses

Previous work investigating cannabis craving in response to emotion manipulation tasks have achieved medium to large effect sizes (Buckner, Ecker, & Vinci, 2013; Buckner, Silgado, & Schmidt, 2011). Given this, power analyses were conducted to be able to detect a medium effect size. The sample necessary to achieve 0.80 power for the ANCOVA with a three-level IV, and six covariates in each model in ANCOVA is 158. The sample necessary to achieve 0.80 power for the hierarchical regression analyses for moderation and mediation analyses with eight predictors (i.e., five covariates, two main effects, and one interaction) is 55.

RESULTS

Data were first inspected for outliers, skew, and kurtosis. All outcome variables (i.e., post-task craving, post-task anxiety, follow-up cannabis use frequency, and follow-up cannabis-related problem severity) were positively skewed, such that *z* scores of skew were greater than 1.96 (Tabachnick & Fidell, 2007). Follow-up cannabis use and cannabis-related problem severity were leptokurtic, such that *z* scores of kurtosis were greater than 1.96. Further, outliers greater than three standard deviations from the mean were observed (n = 8) in post-task state anxiety, follow-up cannabis use, and follow-up cannabis-related problem severity. Hypothesized covariates of trait social anxiety, pre-task cannabis craving, pre-task state anxiety, depression, anxiety, and baseline cannabis use were positively skewed. Among hypothesized covariates, post-event processing, depression, anxiety, and baseline cannabis use were leptokurtic. Further, outliers (n = 16) were observed in pre-task cannabis craving, pre-task state anxiety, trait social anxiety, depression, general anxiety, and baseline cannabis use. In light of these deviations from normality, data for post-task craving, post-task anxiety, follow-up cannabis use frequency, follow-up cannabis-related problem severity, trait social anxiety, pre-task cannabis craving, pre-task state anxiety, depression, anxiety, baseline cannabis use were log transformed. Log transformation resulted in less skew, less leptokurtosis, and elimination of outliers greater than three standard deviations from the mean (Tabachnick & Fidell, 2007). Square-root transformation was also conducted, and resulted in less skew and leptokurtosis, but more outliers remained in the distribution. Given that outliers can greatly influence occurrence of Type 1 and 2 errors and reduce the generalizability of findings (Tabachnick & Fidell, 2007), log transformation was chosen given its adjustments to the distribution resulted in more pronounced reduction of outliers. Untransformed means and standard deviations for independent variables,

covariates, and dependent variables are presented in Table 1. Of note, untransformed mean SIAS score was similar to the mean of a sample of undergraduates that reflected normative levels of social anxiety (Rodebaugh, Woods, Heimberg, Liebowitz, & Schneier, 2006).

Table 1. Untransformed Means and Standard Deviations of Independent Variables, Covariates, and Dependent Variables

	M	*SD*
Social Anxiety	19.34	12.13
Depression	5.06	7.151
General Anxiety	5.51	6.76
Trait Post-Event Processing	40.95	25.77
Baseline Cannabis Use	2.37	4.07
Baseline Cannabis-Related Problem Severity	3.48	4.55
Pre-task State Anxiety	2.23	1.82
Pre-task Cannabis Craving	20.22	26.36
Post-task State Anxiety	2.28	2.02
Post-task Cannabis Craving	20.72	27.56
Follow-up Cannabis Use	3.24	6.13
Follow-up Cannabis-related Problem Severity	3.01	4.10
Negative Feedback-Seeking	19.08	9.24

Seventeen participants reported using cannabis on the day they completed baseline measures. Of these 17 participants, mean time since most recent cannabis use was 193.18 minutes (*SD* = 210.11). In light of work showing that effects of cannabis intoxication tend to peak up to two hours after use, but some effects may last for up to eight hours after use (Curran, Brignell, Fletcher, Middleton, & Henry, 2002), analyses were also run excluding participants who used cannabis within 8 hours of completing the study (*n* = 15) and the pattern of results did not differ from when they were included.

The conditions differed on pre-task levels of state anxiety, pre-task level of craving, and trait social anxiety (Table 1). Specifically, participants in the positive PEP condition reported

Table 2. Correlations Between Demographic Variables, Independent Variables, Covariates, and Dependent Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	-												
2. Baseline Cannabis Use	.18*	-											
3. Social Anxiety	-.01	.04	-										
4. Baseline Cannabis-Related Problem Severity	-.03	.25**	.23**	-									
5. Depression	.05	.09	.44**	.40**	-								
6. General Anxiety	-.08	.23**	.27**	.47**	.60**	-							
7. Trait Post-Event Processing	-.07	.03	.29**	.40**	.31**	.24**	-						
8. Pre-task State Anxiety	-.07	.03	.37**	.32**	.34**	.24**	.48**	-					
9. Pre-task Cannabis Craving	.11	.41**	.17*	.32**	.22**	.28**	.22**	.21**	-				
10. Post-task State Anxiety	-.10	.02	.38**	.35**	.36**	.30**	.47**	.84**	.18*	-			
11. Post-task Cannabis Craving	.13	.41**	.18*	.36**	.25**	.32**	.24**	.22**	.91**	.24**	-		
12. Follow-up Cannabis Use	.24**	.74**	.02	.29**	.12	.20*	.09	.07	.45**	.10	.46**	-	
13. Follow-up Cannabis Related Problem Severity	.04	.32**	.15	.54**	.26**	.37**	.22**	.24**	.31**	.30**	.36**	.42**	-
14. Negative feedback-seeking	.03	-.02	-.16	.09	.00	.01	.01	-.02	.02	.04	.03	.00	.06

Note. All variables except age and negative feedback-seeking were log transformed. *$p < 0.05$ ** $p < 0.01$

greater levels of social anxiety and state anxiety than those in the negative PEP condition. These effects were small and medium, respectively (Table 1). Participants in the control condition reported more pre-task cannabis craving than those in the negative PEP task, which was a small effect. No other differences were significant (Table 1). These three variables were therefore included as covariates when later analyses included covariates. Although differences between groups often pose problems with interpretation when using ANCOVA (i.e., attempting to control for phenomena that represent part of the variable of interest) when those differences represent actual differences at the population level, random assignment to conditions reduces the risk of these problems such that differences between groups are likely artifacts of randomization rather than actual population differences (Miller & Chapman, 2001).

Correlations among study variables are presented in Table 2. Trait social anxiety was significantly, positively related to baseline cannabis-related problems, but was not significantly associated with baseline cannabis use. Tendency to engage in PEP was significantly, positively related to trait social anxiety, depression, and general anxiety. Further, tendency to engage in PEP was significantly related to baseline cannabis-related problem severity, but not baseline cannabis use.

Manipulation Check

Conditions did not differ significantly on post-task state anxiety, and the effect was small (Table 3). Given that pre-task state anxiety significantly differed between the PEP and neutral tasks (Table 3), ANCOVA was conducted to determine effects of the task on post-task state anxiety accounting for pre-task levels of state anxiety. Differences between conditions on post-task state anxiety remained nonsignificant, $F(2,158) = 0.63$, $p = .536$, partial $\eta^2 = 0.01$.

Table 3. Differences Between Conditions on Study Variables

	Total (N = 158)	Negative PEP (n = 55)	Positive PEP (n = 54)	Control (n = 49)	F or χ^2	p	η^2 or Cramer's φ
Age	20.42 (1.58)	20.56 (1.36)[a]	20.33 (1.99)[a]	20.37 (1.30)[a]	0.33	.718	0.00
Gender					2.47	.291	0.13
Men	24%	29%	26%	16%			
Women	76%	71%	74%	84%			
Race/Ethnicity					8.22	.767	0.23
Caucasian/Hispanic	1%	2%	2%	0%			
Caucasian/Non-Hispanic	71%	67%	76%	69%			
African American	15%	18%	11%	16%			
American Indian	1%	0%	0%	4%			
Asian	4%	5%	4%	2%			
Mixed	5%	5%	6%	4%			
Other	3%	2%	2%	4%			
Past-week cannabis use frequency*	0.32 (0.39)	0.24 (0.35)[a]	0.36 (0.39)[a]	0.36 (0.42)[a]	1.76	.176	0.02
Pre-task Cannabis Craving*	0.82 (0.75)	0.59 (0.69)[a]	0.91 (0.73)[a,b]	0.98 (0.79)[b]	4.29	.015	0.05
Pre-task State Anxiety*	0.43 (0.27)	0.34 (0.26)[a]	0.52 (0.25)[b]	0.45 (0.29)[a,b]	6.34	.002	0.08
Trait Social Anxiety*	1.21 (0.32)	1.14 (0.34)[a]	1.30 (0.27)[b]	1.20 (0.35)[a,b]	3.10	.048	0.04
Trait Post-event Processing*	1.46 (0.48)	1.41 (0.49)[a]	1.53 (0.39)[a]	1.45 (0.57)[a]	0.88	.415	0.01
Post-task state anxiety*	0.42 (0.29)	0.37 (0.27)[a]	0.49 (0.27)[a]	0.42 (0.33)[a]	2.64	.074	0.03
Post-task cannabis craving*	0.81 (0.76)	0.63 (0.71)[a]	0.88 (0.76)[a]	0.95 (0.80)[a]	2.49	.087	0.03

(Table 3 continued)

	Total (N = 158)	Negative PEP (n = 55)	Positive PEP (n = 54)	Control (n = 49)	F or χ^2	p	η^2 or Cramer's φ
Follow-up cannabis use frequency*	0.38 (0.43)	0.33 (0.39)[a]	0.39 (0.45)[a]	0.41 (0.45)[a]	0.58	.561	0.01
Follow-up cannabis-related problem severity*	0.48 (0.39)	0.33 (0.32)[a]	0.60 (0.40)[b]	0.50 (0.41)[a,b]	7.12	.001	0.08

Note: Values presented are mean and standard deviation unless noted otherwise. Different superscripts represent significant differences between conditions at $p < 0.05$. *Values log transformed

A second manipulation check was conducted. To assess the degree to which participants engaged in the intended type of PEP, responses form the modified PEPQ that participants completed to enhance engagement in the task were examined. Given that the questions were worded differently in each task to enhance participation in the randomly assigned task, differences between groups were not assessed. In the negative PEP condition, mean degree of belief that their behavior was negative was 28.31 (*SD* = 31.81), and mean degree of belief that their feelings about the event worsened was 26.93 (*SD* = 32.09), suggesting that their thoughts during the task were not very negative, given that the scale ranged from 0 - 100. In the positive PEP condition, mean degree of belief that their behavior was positive was 59.40 (*SD* = 37.60) and the mean degree of belief that their feelings about the event improved was 54.23 (*SD* = 40.34). This descriptive information suggests that participants' thoughts during the positive PEP task were not particularly positive. In the neutral condition, mean degree of thinking about the event after it was over was 26.05 (*SD* = 32.18) and mean degree of difficulty forgetting about the event was 17.36 (*SD* = 30.53).

Hypothesis 1

The ANCOVA testing whether the negative PEP condition would be related to greater post-task cannabis craving after controlling for social anxiety, depression, general anxiety, and pre-task cannabis craving and state anxiety was not significant (Table 4). In light of results of this analysis that showed pre-task state anxiety accounted for minimal variance (Table 4), the analysis was re-run without pre-task state anxiety as a covariate and the pattern of results remained unchanged.

Table 4. Results of ANCOVA with Post-Task Craving as Dependent Variable

	Estimated Marginal Means			*F*	*df*	*p*	Partial η^2
	Negative	Positive	Control				
Covariate							
Social Anxiety				0.03	1,150	.697	0.01
Depression				0.30	1,150	.584	0.00
Anxiety				1.84	1,150	.177	0.01
Pre-task cannabis craving				670.20	1,150	<.001	0.81
Pre-task state anxiety				0.16	1,150	.359	0.01
Main effect							
Condition	0.87	0.78	0.80	1.03	2,150	.359	0.01

Hypothesis 2

The ANCOVA testing whether the negative PEP condition would be related to greater follow-up cannabis use after controlling for social anxiety, depression, general anxiety, and pre-task cannabis craving, state anxiety, and cannabis use was not significant (Table 5).

Table 5. Results of ANCOVA with Follow-Up cannabis Use as Dependent Variable

	Estimated Marginal Means			*F*	*DF*	*p*	Partial η^2
	Negative	Positive	Control				
Covariates							
Social Anxiety				0.83	1,149	.363	0.01

(Table 5 continued)

	Estimated Marginal Means						
	Negative	Positive	Control	*F*	*DF*	*p*	Partial η^2
Depression				0.65	1,149	.422	0.00
Anxiety				0.14	1,149	.711	0.01
Pre-task cannabis craving				9.46	1,149	.002	0.06
Pre-task state anxiety				0.40	1,149	.530	0.03
Past week cannabis use				125.89	1,149	<.001	0.46
Main effect							
Condition	0.41	0.35	0.36	0.06	2,149	.504	0.01

The ANCOVA testing whether the negative PEP condition would be related to greater follow-up cannabis-related problem severity after controlling for social anxiety, depression, general anxiety, pre-task cannabis craving and state anxiety, and pre-task cannabis use, was not significant (Table 6)[1].

Table 6. Results of ANCOVA with Follow-Up Cannabis-Related Problem Severity as Dependent Variable

	Estimated Marginal Means			*F*	*DF*	*p*	Partial η^2
	Negative	Positive	Control				
Covariate							
Social Anxiety				0.05	1,149	.827	0.00
Depression				0.27	1,149	.607	0.00

(Table 6 continued)

	Estimated Marginal Means			*F*	*DF*	*p*	Partial η^2
	Negative	Positive	Control				
Anxiety				2.79	1,149	.097	0.02
Pre-task cannabis craving				4.56	1,149	.034	0.03
Pre-task state anxiety				0.59	1,149	.445	0.00
Baseline cannabis-related problem severity				28.04	1,149	<.001	0.16
Main effect							
Condition	0.45	0.46	0.36	2.20	2,149	.115	0.03

Hypotheses 3 and 4

Hierarchical multiple linear regression analyses testing whether social anxiety would moderate the relationships between PEP conditions and post-task state anxiety (Tables 7-9) were

Table 7. Hierarchical Linear Regression of the Interaction Between Condition (Negative PEP vs. Control) and Social Anxiety Predicting Post-Task State Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.660	97.84			<.001	
Pre-task cannabis craving			0.01	0.45	.654	0.00
Pre-task state anxiety			0.87	13.72	<.000	0.64
Step 2	.012	1.85			.162	
Social anxiety			0.08	1.39	.168	0.01
Condition			0.05	1.34	.184	0.01

(Table 7 continued)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 3	.002	0.69			.408	
Condition X Social Anxiety			0.09	0.83	.408	0.00

Table 8. Hierarchical Linear Regression of the Interaction Between Condition (Positive PEP vs. Control) and Social Anxiety Predicting Post-Task State Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.648	92.04			<.001	
Pre-task cannabis craving			-0.00	-0.18	.860	0.00
Pre-task state anxiety			0.90	13.33	<.000	0.62
Step 2	.003	0.37			.690	
Social anxiety			0.05	0.83	.407	0.01
Condition			0.00	0.12	.906	0.00
Step 3	.001	0.18			.669	
Condition X Social Anxiety			0.05	0.43	.669	0.00

Table 9. Hierarchical Linear Regression of the Interaction Between Condition (Negative PEP vs. Positive PEP) and Social Anxiety Predicting Post-Task State Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.796	206.43			<.001	
Pre-task cannabis craving			-0.00	-0.07	.944	0.00
Pre-task state anxiety			0.92	19.73	<.000	0.75
Step 2	.014	3.70			.028	
Social anxiety			0.09	2.11	.037	0.01

(Table 9 continued)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Condition			0.05	1.90	.060	0.01
Step 3	.001	0.13			.724	
Condition X Social Anxiety			0.03	0.35	.724	0.00

not significant. Given that the covariate of pre-task cannabis craving accounted for minimal variance in these models (Tables 7-9), models were run without pre-task cannabis craving as a covariate. The pattern of findings was unchanged. Hypothesis 4, that social anxiety would moderate relationships between conditions and post-task craving, was not supported, as interactions between condition and social anxiety were not significant (Tables 10-12). Further, covariates of pre-task state anxiety, depression, and general anxiety accounted for minimal

Table 10. Hierarchical Linear Regression of the Interaction Between Condition (Negative PEP vs. Control Task) and Social Anxiety in the Prediction of Post-Task Cannabis Craving

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.841	103.68			<.001	
Pre-task cannabis craving			0.89	18.29	<.001	0.54
Pre-task state anxiety			0.10	0.80	.425	0.00
Depression			0.05	0.54	.594	0.00
Anxiety			0.06	0.71	.480	0.00
Past-week cannabis use			0.00	0.02	.988	0.00
Step 2	.002	0.56			.575	
Social anxiety			-0.01	-0.07	.944	0.00
Condition			0.07	1.05	.295	0.00
Step 3	.001	0.39			.536	

(Table 10 continued)

Condition X Social Anxiety	0.12	0.62	.536	0.00	

Table 11. Hierarchical Linear Regression of the Interaction Between Condition (Positive PEP vs. Control Task) and Social Anxiety in the Prediction of Post-Task Cannabis Craving

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.837	99.41			<.001	
Pre-task cannabis craving			0.88	18.92	<.001	0.60
Pre-task state anxiety			0.07	0.54	.588	0.00
Depression			-0.01	-0.09	.931	0.00
Anxiety			0.15	1.81	.073	0.00
Past-week cannabis use			0.08	0.98	.331	0.00
Step 2	.000	0.09			.910	
Social anxiety			-0.02	-0.19	.852	0.00
Condition			-0.18	-0.07	.947	0.00
Step 3	.000	0.16			.687	
Condition X Social Anxiety			0.09	0.40	.687	0.00

Table 12. Hierarchical Linear Regression of the Interaction Between Condition (Negative PEP vs. Positive PEP) and Social Anxiety in the Prediction of Post-Task Cannabis Craving

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.850	116.34			<.001	
Pre-task cannabis craving			0.91	20.83	<.001	0.63
Pre-task state anxiety			-0.08	-0.03	.503	0.00
Depression			0.06	0.04	.453	0.00

(Table 12 continued)

Anxiety			0.05	0.03	.495	0.00
Past-week cannabis use			0.01	0.04	.342	0.00
Step 2	.004	1.31			.276	
Social anxiety			0.10	0.92	.359	0.00
Condition			0.08	1.38	.170	0.00
Step 3	.000	0.06			.813	
Condition X Social Anxiety			0.05	0.24	.813	0.00

variance. The three regression analyses testing Hypothesis 4 were run without these three variables included, and the interactions remained nonsignificant.

Hypothesis 5

We next tested whether negative PEP would mediate the relationship between social anxiety and post-task cannabis craving. Criterion 1 of mediation, that social anxiety would be positively related to post-task cannabis craving when controlling for pre-task cannabis craving, anxiety, depression, anxiety, and cannabis use, was not supported (Table 13).

Table 13. Hierarchical Linear Regression of Mediation Criterion 1 Testing Social Anxiety as a Predictor of Post-Task Cannabis Craving for Positive Task as a Mediator (Negative Task vs. Control)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.841	103.68			<.001	
Pre-task cannabis craving			0.89	18.29	<.001	0.54
Pre-task state anxiety			0.10	0.80	.425	0.00
Depression			0.05	0.54	.594	0.00
Anxiety			0.06	0.71	.480	0.00

(Table 13 continued)

Past-week cannabis use			0.00	0.02	.988	0.00
Step 2	.000	0.00			.949	
Social anxiety			-0.01	-0.06	.949	0.00

Criterion 2, that social anxiety would be related to condition (negative vs. control) was also not supported (Table 14).

Table 14. Hierarchical Logistic Regression of Mediation Criterion 2 Testing Social Anxiety as a Predictor of Condition (Negative task vs. Control)

	B	*SE*	*Wald*	*OR*	*95% CI*	*p*
Step 1						
Pre-task cannabis craving	-0.55	0.33	2.80	0.58	0.31-1.10	.094
Pre-task state anxiety	-1.79	0.82	2.08	0.31	0.06-1.53	.150
Depression	-0.10	0.59	0.02	0.91	0.28-2.90	.869
Anxiety	-0.16	0.57	0.08	0.86	0.28-2.61	.783
Past-week cannabis use	-0.24	0.63	0.15	0.79	0.23-2.69	.786
Step 2						
Negative Task	0.03	0.68	0.00	1.02	0.27-3.87	.971

Criterion 3 that condition (i.e., negative vs. control) would predict post-task craving after controlling for social anxiety was also not significant (Table 15).

Table 15. Hierarchical Linear Regression of Mediation Criterion 3 Testing Condition (Negative Task vs. Control) as a Predictor of Post-Task Cannabis Craving When Controlling for Trait Social Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.841	103.68			<.001	

(Table 15 continued)

Pre-task cannabis craving			0.89	18.29	<.001	0.54
Pre-task state anxiety			0.10	0.80	.425	0.00
Depression			0.05	0.54	.594	0.00
Anxiety			0.04	0.71	.480	0.00
Past-week cannabis use			0.00	0.02	.988	0.00
Step 2	.000	0.00			.949	
Social anxiety			-0.01	-0.06	.949	0.00
Step 3	.002	1.12			.295	
Negative task			0.07	1.05	.295	0.00

Criterion 4, that condition would remain related to post-task craving when controlling for social anxiety, was not significant (Table 16).

Table 16. Hierarchical Linear Regression of Mediation Criterion 4 Testing Trait Social Anxiety as a Predictor of Post-Task Cannabis Craving When Controlling for Condition (Negative Task vs. Control)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.841	103.68			<.001	
Pre-task cannabis craving			0.89	18.29	<.001	0.54
Pre-task state anxiety			0.10	0.80	.425	0.00
Depression			0.05	0.54	.594	0.00
Anxiety			0.04	0.71	.480	0.00
Past-week cannabis use			0.00	0.02	.988	0.00
Step 2	.002	1.12			.293	
Negative Task			0.07	1.06	.293	0.00

(Table 16 continued)

Step 3	.000	0.01			.944	
Social Anxiety			-0.01	-0.07	.944	0.00

In light of the finding that pre-task state anxiety, depression, and anxiety accounted for very minimal amounts of variance in the models (Tables 13-16), regression analyses testing mediation were run without those variables as covariates, and the pattern of findings remained nonsignificant.

It was next tested whether positive PEP would mediate the relationship between social anxiety and post-task cannabis craving. Criterion 1, that social anxiety was related to post-task cannabis craving, remained unsupported (Table 17).

Table 17. Hierarchical Linear Regression of Mediation Criterion 1 Testing Social Anxiety as a Predictor of Post-Task Cannabis Craving for Positive Task as a Mediator (Positive Task vs. Control)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.837	99.41			<.001	
Pre-task cannabis craving			0.88	18.92	<.001	0.60
Pre-task state anxiety			0.07	0.54	.588	0.00
Depression			-0.01	-0.09	.931	0.00
Anxiety			0.15	1.81	.073	0.00
Past-week cannabis use			0.08	0.98	.331	0.00
Step 2	.000	0.14			.710	
Social anxiety			-0.04	-0.37	.710	0.00

Criterion 2, that the social anxiety would be related to condition (positive vs. control), was also unsupported (Table 18).

Table 18. Hierarchical Logistic Regression of Mediation Criterion 2 Testing Social Anxiety as a Predictor of Condition (Positive task vs. Control)

	B	*SE*	*Wald*	*OR*	*95% CI*	*p*
Step 1						
Pre-task cannabis craving	-0.24	0.30	0.67	0.78	0.44-1.41	.413
Pre-task state anxiety	1.11	0.82	1.88	3.02	0.62-14.71	.171
Depression	-0.10	0.59	0.69	1.62	0.52-5.08	.407
Anxiety	0.48	0.57	0.42	0.70	0.24-2.03	.515
Past-week cannabis use	0.23	0.63	0.19	1.26	0.44-3.66	.666
Step 2						
Positive Task	1.01	0.78	1.67	2.75	0.59-12.76	.196

Criterion 3, that condition (positive vs. control) would predict post-task craving after controlling for social anxiety, was unsupported (Table 19).

Table 19. Hierarchical Linear Regression of Mediation Criterion 3 Testing Condition (Positive vs. Control) as a Predictor of Social Post-Task Cannabis Craving When Controlling for Trait Social Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.837	99.41			<.001	
Pre-task cannabis craving			-0.08	18.92	<.001	0.60
Pre-task state anxiety			0.02	0.54	.588	0.00
Depression			-0.01	-0.09	.931	0.00
Anxiety			0.15	1.81	.073	0.00
Past-week cannabis use			0.08	0.98	.331	0.00
Step 2	.000	0.14			.710	

(Table 19 continued)

Social anxiety			-0.04	-0.37	.710	0.00
Step 3	.000	0.05			.823	
Positive task			-0.02	-0.22	.823	0.00

Criterion 4, that condition would remain related to post-task craving when controlling for social anxiety, was not significant (Table 20).

Table 20. Hierarchical Linear Regression of Mediation Criterion 4 Testing Trait Social Anxiety as a Predictor of Post-Task Cannabis Craving When Controlling for Condition (Positive Task vs. Control)

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.837	99.41			<.001	
Pre-task cannabis craving			0.88	18.91	<.001	0.60
Pre-task state anxiety			0.07	0.54	.588	0.00
Depression			-0.01	-0.09	.931	0.00
Anxiety			0.15	1.81	.073	0.00
Past-week cannabis use			0.08	0.98	.331	0.00
Step 2	.000	0.07			.787	
Positive Task			-0.02	-0.27	.787	0.00
Step 3	.000	0.12			.735	
Social Anxiety			-0.04	-0.34	.735	0.00

Again, pre-task state anxiety, depression, and anxiety accounted for very minimal amounts of variance in the models (Table 17-20), these analyses were run without those variables as covariates, and the pattern of findings was unchanged.

Although mediation was not supported, Criterion 2 in both sets of analyses may have been nonsignificant because condition was randomly assigned and there is no reason to believe that social anxiety would be related to randomly assigned condition. In light of this limitation, structural equation modeling (SEM) was used to test the effect of social anxiety indirectly through condition in the prediction of post-task cannabis craving. SEM was conducted using Mplus (Muthén & Muthén, 2011), a statistical software package for latent variable and path analytic approaches. The models tested included pre-task cannabis craving as a covariate, and tested the direct effect of social anxiety on post-task cannabis craving and the indirect effect of social anxiety on post-task craving through condition. Two separate models were tested for each possible mediator-- the first tested negative PEP vs. control conditions and the second tested positive PEP vs. control conditions as mediators, respectively. Dummy coding employed by the hierarchical linear regression model was retained. Indicators of a model that is a good fit include non-significant χ^2 value ($p > 0.05$; Barrett, 2007; Hooper, Coughlan, & Mullen, 2008), Root Mean Square Error of Approximation (RMSEA) values between 0.05 and 0.08 (Browne & Cudeck, 1993; Hancock & Freeman, 2001), and a comparative fit index (CFI) value greater than 0.9 (Hooper et al., 2008). The model testing negative PEP as a mediator did not represent a good fit, χ^2 (3) = 11.97, p = .008, RMSEA = 0.17, 90% CI 0.01, 0.28, CFI = 0.02. The model testing positive PEP as a mediator was also not indicative of a good fit, χ^2 (3) = 10.86, p = .001, RMSEA = 0.16, 90% CI: 0.07, 0.27, CFI = 0.04.

Hypothesis 6

Hierarchical multiple linear regression analysis was not significant when testing condition (negative PEP vs. control) as a moderator of the relationships between social anxiety and post-task cannabis use (Table 21).

Table 21. Hierarchical Linear Regression of the Interaction Between Condition (Negative Task vs. Control Task) and Social Anxiety in the Prediction of Follow-Up Cannabis Use

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.569	25.90			<.001	
Pre-task cannabis craving			0.07	2.13	.036	0.00
Pre-task state anxiety			0.09	0.68	.496	0.00
Depression			0.07	0.05	.964	0.00
Anxiety			-0.03	-0.34	.732	0.00
Past-week cannabis use			0.70	8.37	<.001	0.31
Step 2	.006	0.71			.495	
Social anxiety			-0.08	-0.86	.384	0.00
Condition			-0.05	0.81	.418	0.00
Step 3	.002	0.43			.515	
Condition X Social Anxiety			0.11	0.65	.515	0.00

The positive PEP condition (vs. control) also did not moderate the relationship between social anxiety and follow-up cannabis use (Table 22).

Table 22. Hierarchical Linear Regression of the Interaction Between the Condition (Positive Task vs. Control Task) and Social Anxiety in the Prediction of Follow-Up Cannabis Use

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.618	31.38			<.001	
Pre-task cannabis craving			0.11	2.64	.010	0.03
Pre-task state anxiety			0.04	0.34	.733	0.00
Depression			0.08	0.97	.332	0.00

(Table 22 continued)

Anxiety			-0.03	0.42	.679	0.00
Past-week cannabis use			0.76	10.11	<.001	0.40
Step 2	.009	1.09			.339	
Social anxiety			-0.15	-1.44	.153	0.01
Condition			-0.01	-0.14	.888	0.00
Step 3	.001	0.16			.692	
Condition X Social Anxiety			0.08	0.40	.692	0.00

Further, the negative PEP condition vs. positive PEP condition did not moderate the relationship between social anxiety and follow-up cannabis use (Table 23).

Table 23. Hierarchical Linear Regression of the Interaction Between the Condition (Negative Task vs. Positive Task) and Social Anxiety in the Prediction of Follow-Up Cannabis Use

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.569	40.07			<.001	
Pre-task cannabis craving			0.10	2.94	.004	0.02
Pre-task state anxiety			0.02	0.18	.860	0.00
Depression			0.03	0.48	.634	0.00
Anxiety			-0.02	0.35	.726	0.00
Past-week cannabis use			0.72	11.21	<.001	0.36
Step 2	.004	0.74			.477	
Social anxiety			-0.07	-0.90	.369	0.00
Condition			-0.04	-0.74	.460	0.00
Step 3	.000	0.08			.786	

(Table 23 continued)

Condition X Social Anxiety	0.05	0.27	.692	0.00

Given that depression and anxiety accounted for nearly no variance in the model, analyses were run without their inclusion as covariates. The pattern of results remained the same when depression and anxiety were excluded from these models.

Secondary Aim

To test whether negative feedback-seeking mediated the relation of social anxiety with post-task anxiety among those in the positive PEP condition, Criterion 1, social anxiety was related to post-task state anxiety was significant (Table 24).

Table 24. Hierarchical Linear Regression of Mediation Criterion 1 Testing Social Anxiety's Relation to Post-Task Anxiety in the Positive Task, Testing Negative Feedback-seeking as a Mediator of the Relationship Between Social Anxiety and Post-Task State Anxiety

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.080	4.52			.038	
Pre-task state anxiety			0.30	2.13	.038	0.08
Step 2	.066	3.96			.052	
Social Anxiety			-0.01	-1.99	.052	0.06

Criterion 2, that social anxiety would significantly predict negative feedback-seeking, was not significant (Table 25).

Table 25. Hierarchical Linear Regression of Mediation Criterion 2 Testing Social Anxiety's Relation to Negative Feedback-seeking

	ΔR^2	ΔF	*B*	*t*	*p*	sr^2
Step 1	.772	176.16			<.001	
Pre-task state anxiety			0.95	13.27	<.001	0.77

(Table 25 continued)

Step 2	.004	0.84			.363	
Social anxiety			0.06	0.92	.363	0.02

We tested whether social anxiety was robustly related to post-task state anxiety after controlling for negative feedback-seeking and found that social anxiety remained related to post-task state anxiety after controlling for negative feedback-seeking (Table 26).

Table 26. Hierarchical Linear Regression of Mediation Criterion 3 Testing Negative Feedback-seeking's Relation to Post-Task State Anxiety When Controlling for Social Anxiety

	ΔR^2	ΔF	B	t	p	sr^2
Step 1	.772	176.16			<.001	
Pre-task state anxiety			0.95	13.27	<.001	0.77
Step 2	.004	0.84			.363	
Social Anxiety			0.06	0.92	.363	0.02
Step 3	.000	0.11			.747	
Negative feedback-seeking			-0.01	-0.32	.747	0.00

Criterion 4, that the negative feedback-seeking would remain related to post-task anxiety, when controlling for social anxiety was not significant (Table 27).

Table 27. Hierarchical Linear Regression of Mediation Criterion 4 Testing Social Anxiety's Relation to Post-Task State Anxiety When Controlling for Negative Feedback Seeking

	ΔR^2	ΔF	B	t	p	sr^2
Step 1	.772	176.16			<.001	
Pre-task state anxiety			0.95	13.27	<.001	0.77
Step 2	.001	0.31			.579	

(Table 27 continued)

Negative feedback-seeking			-0.00	-0.56	.579	0.02
Step 3	.003	0.62			.433	
Social Anxiety			0.06	0.79	.433	0.00

Thus, negative feedback-seeking does not account for a significant amount of variance in the relationship between social anxiety and post-task state anxiety in the positive task.

Post-Hoc Analysis

Given the significant positive correlation between baseline tendency to engage in PEP and baseline cannabis-related problem severity, PEP was tested as a mediator of the relationship between baseline social anxiety and cannabis-related problem severity. This mediation was tested using bootstrapping, which is robust to deviations from normality (A. F. Hayes, 2013). Therefore, untransformed values of the social anxiety, PEP, and cannabis-related problem severity were used. The PROCESS macro for SPSS (IBM Corp, 2013), which uses an ordinary least squares-based path analysis to test direct and indirect effects (A. F. Hayes, 2013), was used to test the mediation model. The indirect effect was tested with bias-corrected bootstrap estimates (10,000 samples) used to construct 95% confidence intervals (CIs). Baseline cannabis use frequency as measured by the TLFB was included as a covariate. The total effects model accounted for significant variance, $R^2 = 0.16$, $df = 2,155$, $F = 15.16$, $p < .001$, as did the full model with PEP included, $R^2 = 0.23$, $df = 3,155$, $F = 15.51$, $p < .001$. The direct effect of social anxiety when controlling for PEP remained significant, $B = 0.06$, $SE = 0.01$, $p = .004$. The indirect effect was estimated and was significant, $B = 0.02$, bootstrap $SE = 0.01$, 95% CI: 0.01, 0.04, suggesting that social anxiety is related to cannabis-related problems indirectly through tendency to engage in PEP when accounting for cannabis use frequency.

DISCUSSION

The current study utilized a web-based experimental task to determine whether PEP predicts cannabis craving, cannabis use, and cannabis-related problems, especially among those with greater social anxiety. 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 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 at when controlling for cannabis use frequency at baseline. Given that individuals with clinical levels of social anxiety are especially prone to engage in PEP (Fehm et al., 2008; Kocovski et al., 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-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. Several treatment approaches that target PEP have been employed with socially anxious individuals. First, 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 also been shown to reduce both engagement in PEP and distress related to PEP (Blackie & Kocovski, 2015), although another study did not observe reductions in PEP-related distress due to distraction (Cassin & Rector, 2011). Further, 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 malleability of PEP, and the ability to reduce its impact on social anxiety through psychosocial interventions. 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 (Buckner et al., 2016). It may be that integration of strategies that aim to reduce PEP such as cognitive restructuring (a CBT skill) or mindfulness may be targets of such integrated treatments among individuals with co-occurring SAD and CUD. Further, given that tendency to engage in negative PEP was related to greater endorsement of cannabis-related problem severity at baseline, such treatment approaches (e.g., cognitive restructuring of PEP) might also be beneficial in treatment approaches that address cannabis use singularly.

Unexpectedly, the negative PEP condition was unrelated to post-task cannabis variables. This may be in part due to the finding that our negative PEP task did not increase state anxiety, counter to prediction and prior work (Field & Morgan, 2004). Further, the strength of the effect was small in the current study, but larger in Field & Morgan, potentially indicating that an online PEP induction as conducted in the current study does not affect PEP, whereas a lab study may have more of an effect. Lack of impact of negative PEP on state anxiety in our study may be due in part to other methodological differences. In the Field and Morgan study, participants engaged in PEP (whether negative or positive) verbally in a laboratory setting, whereas participants in the

current study participated by writing in an online form. Although efforts were made to increase engagement in the task (i.e., inclusion of questions that further induce PEP after writing task), it may be that participants were somewhat less engaged in the task given that participants were able to complete the task in potentially more comfortable surroundings. In fact, participants did not rate the negative PEP task very negatively, suggesting that the negative task did not induce negative PEP strongly. Future work using tasks shown to more strongly induce negative PEP will be an important next step.

Although participants completed the task in their natural environment where they presumably are engaging in PEP, it may also be that online participants could potentially disengage during participation more readily than those in a laboratory setting. Further, it may be that participants avoided full participation in the task due to avoidance of the anxiety-provoking aspects of the task, which is somewhat supported by PEP ratings during the task as described above. Prior work has found that among cannabis users, social anxiety is positively related to avoidance of internal stimuli (i.e., experiential avoidance; Buckner, Zvolensky, et al., 2014). PEP may have been one such stimulus in the current study which participants avoided, thereby not fully experiencing anxiety induction of the task. Further, one study found that avoidance of internal stimuli is related to greater anxiety in higher demand tasks (i.e., intimate conversation) but not in lower socially demanding tasks (i.e., small talk; Kashdan et al., 2014). Although the sample as whole endorsed relatively low social anxiety such that the untransformed mean SIAS score was consistent with non-clinical samples (Rodebaugh et al., 2006), 11% of participants scored at or above the clinical cut score on the SIAS (34; Heimberg, Mueller, Holt, & Hope, 1992). It may be that among participants who did report clinically significant social anxiety, avoidance of internal stimuli contributed to the difference in findings between the current study

and Field and Morgan (2004). Specifically, it may be that less anxiety was experienced during the current online task because they were less engaged due to its potentially less demanding nature, which may have provided less social demand than the in-person task employed in prior work.

It was hypothesized in the current study that cannabis users who engaged in negative or positive PEP would experience greater cannabis craving after completing the task than those who completed a neutral control task. This hypothesis was not supported, suggesting that cannabis users who participate in a web-based PEP induction may not experience heightened craving. One interpretation of this finding is that experimentally induced PEP, whether negative or positive, does not acutely affect cannabis craving. Given that the manipulation did not result in increased state anxiety, and state anxiety has been related to greater craving among cannabis users undergoing laboratory anxiety-induction tasks (Buckner, Ecker, & Vinci, 2013; Buckner, Silgado, & Schmidt, 2011), the current task may not have had a robust enough effect on state anxiety to impact craving. It may also be that PEP was not anxiety-provoking in this sample, given that the mean social anxiety score was similar to normative levels endorsed by the general population (Heimberg et al., 1992) and the relation of PEP to state anxiety is greater among those with clinically elevated social anxiety (Field & Morgan, 2004). Future work is necessary to test whether PEP is related to cannabis craving, use, and use-related problems among users with clinically elevated social anxiety.

Further, counter to prediction and prior work (Field & Morgan, 2004), social anxiety did not interact with condition to predict greater post-task anxiety in the PEP conditions. Similarly the hypotheses that trait social anxiety would interact with task conditions to predict post-task cannabis craving and follow-up cannabis use were not supported. Given that prior work has

shown that anxiety-provoking tasks relate to increased cannabis craving and social anxiety among socially anxious cannabis users (Buckner, Ecker, & Vinci, 2013; Buckner, Silgado, & Schmidt, 2011), it may be that the task was not sufficiently acutely anxiety-provoking to increase cannabis craving, as tasks used in these studies have involved in-person speech and interaction tasks. Similarly, PEP did not mediate the relationship between social anxiety and cannabis craving. Given that social anxiety was not related to greater post-task craving in either PEP condition, it may be then that PEP of either type is not a primary mechanism that influences cannabis craving, especially when PEP does not lead to increased state anxiety.

The secondary aim tested the meditational role of negative self-verification in the relationship of social anxiety and post-task anxiety among those in the positive task. This mediation was not supported, suggesting that negative feedback-seeking, an indicator of negative self-verification, is not a mechanism through which positive PEP is related to greater state anxiety among socially anxious individuals as observed in prior work (Valentiner et al., 2011).

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. Future work may benefit from recruitment of a more diverse sample to determine if these results are generalizable to other populations. Second, the task was completed online in a more naturalistic environment. In one sense, this was a strength of the design, as this provided a test of PEP in as it may occur in participants' lives, potentially isolating other effects that could contribute to state social anxiety above and beyond PEP in other laboratory based studies (e.g., visiting a laboratory environment, interacting with research assistants). However, this may have provided participants with an opportunity to disengage from the task (e.g., looking at other

websites, talking to other people). Future work should incorporate naturalistic designs that better capture PEP as it occurs (e.g., ecological momentary assessment). Third, this study relied on self-report for measures of state anxiety. Future work may benefit from measurement of physiological markers of anxiety and cannabis craving such as heart rate and skin conductance. Fourth, given that the current study was conducted with a non-clinical sample, it may be that samples of individuals with more clinically significant social anxiety and/or cannabis-related problems may exhibit proposed relationships more than a non-clinical sample.

Conclusions

Although study hypotheses related to the PEP task were not supported, this study's findings highlight the importance of investigation of constructs that could underlie the striking relationship between social anxiety and cannabis use and related problems. Specifically, PEP was positively related to cannabis-related problem severity and mediated the relationship between social anxiety and cannabis-related problem severity at baseline. Thus, PEP may be an especially important target of cognitive restructuring among individuals with co-occurring social anxiety and cannabis-related problems. Findings of the current study highlight the importance of continued efforts to identify cognitive vulnerabilities that underlie the relationship between social anxiety and cannabis problems to ultimately improve prevention and treatment efforts.

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APPENDIX A
ENDNOTE

[1]Although patterns of findings when variables were not transformed were generally the same as when transformed, ANCOVA with follow-up cannabis-related problems as the dependent variable when variables were not transformed was significant, although the effect size was similar, partial $\eta^2 = 0.04$.

APPENDIX B
POST-EVENT PROCESSING TASK TEXT

Negative Post-event processing:

Please think of a recent social situation. Please describe that situation in as much detail as possible, including details about negative aspects of your performance or others' negative reactions to your performance.

Please rate the following questions from 0 (never, not at all) -100 (never, very much):

1) In my memories about the event, I saw myself (my behavior, my attributes) in a negative way.
2) As you thought about the event, did your feelings about the event worsen?

Positive Post-event processing:

Please think of a recent social situation. Please describe that situation in as much detail as possible, including details about positive aspects of your performance or others' positive reactions to your performance.

_____

Please rate the following questions from 0 (never, not at all) -100 (never, very much):

1) In my memories about the event, I saw myself (my behavior, my attributes) in a positive way.
2) As you thought about the event, did your feelings about the event improve?

Neutral Control Task:

Please think of a topic you recently learned about in class. Please describe that topic in as much detail as possible.

_____

Please rate the following questions from 0 (never, not at all) -100 (never, very much):

1. Did you find it easy to forget about the event?
2. How much did you think of the event after it was over?

APPENDIX C
IRB APPRROVAL FORM

ACTION ON PROTOCOL APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu | lsu.edu/irb

TO: Julia Buckner
Psychology

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: March 11, 2015

RE: **IRB#** 3599

TITLE: Post-Event Processing Study

New Protocol/Modification/Continuation: New Protocol

Review type: Full ___ Expedited X **Review date:** 3/11/2015

Risk Factor: Minimal ___X___ Uncertain _____ Greater Than Minimal_____

Approved_____X_____ **Disapproved**_____

Approval Date: 3/11/2015 **Approval Expiration Date:** 3/10/2016

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 200

LSU Proposal Number (if applicable): _____

Protocol Matches Scope of Work in Grant proposal: (if applicable) _____

By: Dennis Landin, Chairman _____

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. SPECIAL NOTE:

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

VITA

Anthony Ecker received a Bachelor of Science Degree in psychology from Louisiana State University in 2009 and Master of Arts in clinical psychology from Louisiana State University in 2013. Mr. Ecker's doctoral work in clinical psychology at Louisiana State University has been under the mentorship of Dr. Julia Buckner. Mr. Ecker is currently on predoctoral clinical internship at the Veterans Administration Connecticut Healthcare System in West Haven, Connecticut. Mr. Ecker's research interests include the etiology, maintenance, and treatment of co-occurring anxiety and substance use disorders.