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Posttraumatic Stress Disorder Symptoms and Coping Motives are Independently Associated with Cannabis Craving Elicited by Trauma Cues

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Cannabis use is common among individuals with posttraumatic stress disorder (PTSD), although its use can ultimately worsen PTSD outcomes. Cannabis-use coping motives may help explain the PTSD–cannabis relationship. Frequent pairing of trauma cues with substance use to cope with negative affect can lead to conditioned substance craving. For the present cue-reactivity study, we examined if PTSD symptoms were associated with cannabis craving elicited by a personalized trauma cue and explored whether coping motives mediated this hypothesized relationship; enhancement motives were included as a comparison mediator. Participants ($N = 51$) were trauma-exposed cannabis users who completed validated assessments on PTSD symptom severity and cannabis use motives. They were then exposed to a personalized audiovisual cue based on their own traumatic experience after which they responded to questions on a standardized measure regarding their cannabis craving. The results demonstrated that PTSD symptoms were associated with increased cannabis craving following trauma cue exposure, $B = 0.43$, $p = .004$, 95% CI [0.14, 0.72]. However, the results did not support our hypothesis of an indirect effect through general coping motives, indirect effect $= .03$, $SE = .08$, 95% CI [−.10, .21]. We found an independent main effect of general coping motives on trauma cue–elicited cannabis craving, $B = 1.86$, $p = .002$, 95% CI [0.72, 3.01]. These findings have important clinical implications suggesting that clinicians should target both PTSD symptoms and general coping motives to prevent the development of conditioned cannabis craving to trauma reminders in trauma-exposed cannabis users.

Cannabis use by trauma-exposed individuals is a common phenomenon, making it a timely issue in both clinical and research settings (Cougle et al., 2011). Previous research has established positive associations between cannabis use and the presence of a posttraumatic stress disorder (PTSD) diagnosis among individuals with trauma histories (Kevorkian et al., 2015), and although cannabis is widely used to treat PTSD symptoms (Bowles, 2012), heavy cannabis use poses a risk of developing cannabis use disorder (CUD; Kevorkian et al., 2015). A lack of PTSD symptom changes following treatment can also predict higher rates of cannabis use (Bonn-Miller et al., 2011). The rates of CUD appear to be on the rise within trauma-

exposed populations, as there has been a 50% increased prevalence in CUD among veterans between 2002 and 2009 (Bonn-Miller et al., 2012). Despite the high prevalence of cannabis use as a part of PTSD treatment, Wilkinson et al. (2015) found cannabis use to be associated with more severe PTSD symptoms, elevated violent behavior, and higher levels of alcohol use. This discrepancy highlights the need for more research on whether cannabis use has unintended negative consequences among individuals with PTSD and the mechanisms that could lead to these harms.

One such mechanism may involve motives for cannabis use. Individuals use cannabis for a multitude of reasons, including to get high (i.e., enhancement motives), to manage negative affect (i.e., coping motives), and to affiliate (i.e., social motives; Cooper, 1994). Coping motives, or the use of cannabis to manage negative affect, are commonly endorsed among trauma-exposed individuals (Bonn-Miller et al., 2014). Cannabis coping motives can help explain the potential negative consequences of cannabis use among individuals with PTSD given their links to increased cannabis use and more cannabis-related problems (Bonn-Miller et al., 2007; Bujarski, Norberg, et al., 2012) as well as their associations with poorer mental health outcomes compared to socially motivated use and

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nonuse (Brodbeck et al., 2007). As studies have shown that individuals with more severe PTSD symptoms use cannabis more often to regulate negative affect (e.g., Boden et al., 2013), their coping-motivated use could lead to more problematic cannabis use and a worsening of PTSD symptoms in the long term.

It is interesting to note that cannabis coping motives could theoretically contribute to the development of conditioned cannabis craving in response to trauma cues. With cue-elicited substance craving, environmental cues, such as cannabis paraphernalia, that are frequently paired with substance use can, over time, come to evoke a drug-craving response upon presentation of the drug-related environmental cues alone (Jansen, 1998). Similarly, someone who frequently uses substances to cope with trauma reminders can theoretically develop conditioned associations between the trauma cues, substance use behavior, and relief consequences (i.e., the drug's dampening of negative affect to the trauma cue). This repeated pairing can lead to a response of conditioned craving for the substance when the individual is exposed to trauma cues in the future. Such conditioned drug craving to trauma cues has been demonstrated in the context of alcohol and cocaine. Specifically, individuals with comorbid PTSD and substance use disorder exhibited increased substance craving following a combined trauma and substance cue compared to neutral cues (Coffey et al. 2002, 2006, 2010).

To our knowledge, no studies to date have examined conditioned cannabis craving to trauma cues or explored cannabis-use motives as potential mediators of the association between PTSD symptoms and cannabis craving in response to trauma-cue exposure. There is also a need to examine trauma-specific cues, as previous studies have utilized combined trauma- and substance-related cues (Coffey et al., 2002, 2006, 2010). Filling these gaps is important to help understand potential risks of cannabis as a treatment for PTSD, such as conditioned cannabis craving, and to identify a process conferring risk, such as cannabis use to cope, among individuals with more severe PTSD symptoms.

We examined coping motives as a mediator of the association between PTSD symptoms and trauma cue–elicited cannabis craving. In addition, we examined the potential role of an alternate emotional regulation motivation for cannabis use, namely enhancement motives (i.e., cannabis use to increase positive affect), to determine if our hypothesized mediation was specific to coping motives or if the effect was generalizable to motives that aim to alter affective states more globally. Coping and enhancement motives were the only cannabis-use motives included as potential mediators, as they both center around cannabis use to alter affective states. Our theoretical model of conditioned cannabis craving centered on cannabis dampening negative affect, which is why coping motives were included. Furthermore, as PTSD can involve alterations in emotional processing (Tull et al., 2016), it is possible that individuals with PTSD use cannabis both to dampen their negative affect (i.e., coping motives) and to experience increased positive affect (i.e., enhance-

ment motives); thus, both mood regulation motives were tested as potential mediators in the present study. We hypothesized that PTSD symptoms would be predictive of increased cannabis craving after exposure to a personalized trauma cue. We also hypothesized that cannabis coping motives, but not enhancement motives, would mediate the relation between PTSD symptom severity and trauma cue–elicited cannabis craving; that is, individuals with more severe PTSD symptoms would experience increased conditioned craving to trauma cues due to their higher tendency to use cannabis to cope, thus facilitating increased learning history with regard to associating trauma cues with cannabis use.

Method

Participants

The study included a community sample of 51 cannabis users with a history of trauma exposure, as defined in the fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*-5; American Psychiatric Association [APA], 2013). Participants were recruited using flyers and online advertisements. To be eligible to participate, individuals were required to use cannabis at least once a week and to have experienced at least one lifetime traumatic event. Participants were excluded if they were under 19 years of age; self-reported a diagnosis of severe mental illness (i.e., schizophrenia, other psychosis, or bipolar disorder); or, for women, were pregnant, planning to get pregnant, or nursing a child. Participants were predominantly White (72.5%) and male (54.9%) and reported a yearly income of less than $20,000 (CDN; 56.9%). The mean participant age was 34.61 years (*SD* = 13.01, range: 19–61). Most participants reported daily or almost daily cannabis use (51.0%). Regarding educational attainment, the largest group of participants (41.2%) were college or university graduates, with 37.3% of participants currently enrolled in schooling. Most participants lived alone (33.3%) or with a partner (29.4%). Only 29.4% of participants had children, most of whom had two children (53.3%). Additional details on the demographic characteristics of the sample can be found in Table 1.

Procedure

The study was approved by the Nova Scotia Health Authority Research Ethics Board (Romeo #: 1022325). Individuals underwent three stages of participation: a telephone screening for eligibility and two in-lab sessions. For the screening, respondents were asked a series of questions on demographics characteristics, the nature of their most traumatic experience, their PTSD symptoms, and their patterns of cannabis use. Eligible respondents were invited to schedule their first in-lab session.

For Session 1, written consent for the study was first obtained. Next, participants completed an audio-recorded face-to-face interview to obtain details on the event they identified as

Table 1

Demographic and Cannabis Use Characteristics

Variable	%
Gender	
Men	54.9
Women	43.1
Other	2.0
Race/ethnicity[a]	
White	72.5
Black	9.8
Biracial	3.9
Indigenous	7.8
Asian	9.8
Other	7.8
CUDIT-R[b]	37.3[c]
Cannabis use	
Weekly	34.7
Daily/almost daily	51.0
Multiple times daily	14.3

Note. CUDIT-R = Cannabis Use Disorders Identification Tests–Revised. [a] Not mutually exclusive. [b] Data entry error resulted in 20–24 missing values for Items 2 and 8 on the CUDIT-R. Missing values were dealt with using the mean substitution method. [c] Percentage of participants who met the cutoff score (i.e., ≥ 13) for likely cannabis dependence.

their most traumatic life experience. All events qualified as Criterion A events (i.e., exposure to or threatened death or injury) per the *DSM-5* PTSD diagnostic criteria (APA, 2013) and were chosen from the included items on the Life Events Checklist for *DSM-5* (LEC-5; Weathers, Blake, et al., 2013). Examples of traumatic experiences endorsed within the present sample included home invasion, sexual assault, motor vehicle accident, and physical altercation. The interview was used to develop a personalized trauma script and to select an accompanying image to use during a standardized exposure to sequential audio and visual cues, as used in previous cue-exposure and substance use studies (Sinha & Tuit, 2012).

Between sessions, participants were provided take-home questionnaires to complete, including a measure of cannabis use motives. In Session 2, participants first listened to a 3-min audiotaped vignette with their eyes closed. This neutral baseline event (i.e., brushing their teeth) was the same for all participants. Individuals then listened to a recording of the same length that summarized their personal traumatic experience. Audio cues for all participants followed a standardized length of 3 min (see Sinha & Tuit's 2012 guidelines). After each cue, participants were prompted to open their eyes and continue imagining the scenario while viewing the related visual cue, which had been selected based on the participant's traumatic experience (e.g., a picture of a car wreck if the traumatic event was a vehicular accident) for 2 min. Immediately after exposure to each cue, participants completed the Marijuana Craving Questionnaire–Short Form (MCQ-SF).

Measures

Traumatic Event History

Participants completed the LEC-5 (Weathers, Blake, et al., 2013) to identify their most traumatic life event; each participant's most distressing event was used to select their audio and visual trauma cues. The LEC-5 consists of 17 items that describe traumatic events commonly associated with PTSD. Respondents indicate if an event has happened to them, they witnessed it, they learned about it, or if it is part of their job. The LEC has exhibited good test–retest reliability and convergent validity with other trauma measures (Gray et al., 2004).

PTSD Symptoms

The PTSD Checklist for *DSM-5* (PCL-5; Weathers, Litz, et al., 2013; Blevins et al., 2015) was used to assess PTSD symptom levels during the initial phone screen. The PCL-5 is a 20-item self-report measure on which respondents are asked how much they have been bothered by a given PSTD symptom over the past month. Responses are scored on a scale of 0 (*not at all*) to 4 (*extremely*), with total scores ranging from 0 to 80. Participants were asked to answer PCL-5 items based on their most traumatic event identified on the LEC-5. A score of 33 or higher was used as a threshold for a likely PTSD diagnosis. The measure has shown good test-retest reliability ($r = .82$) as well as convergent ($rs = .74$–.82) and discriminant validity ($rs = .31 − .60$; Blevins et al., 2015). In the present sample, Cronbach's alpha was .93.

Cannabis Use

The eight-item Cannabis Use Disorders Identification Test–Revised (CUDIT-R; Adamson et al., 2010) was used to assess participants' cannabis use and the rates of cannabis dependence over the last 6 months. Items 1–7 are ranked on a scale of 0 (*never*) to 4 (*4 or more times a week/daily or almost daily*), whereas Item 8 has three answer choices, which can be scored as 0 (*never*), 2 (*yes, but not in the past 6 months*), and 4 (*yes, during the past 6 months*). The questionnaire has demonstrated good internal consistency and test–retest reliability as well as discriminant validity and high sensitivity (i.e., 90%) for detecting CUD. The established cutoff score for likely cannabis dependence is 13 or higher (Adamson et al., 2010). In the present sample, Cronbach's alpha was .79.

Cannabis Use Motives

The 25-item Marijuana Motives Measure (MMM; Simons et al., 1998) was used to assess participants' cannabis use motives. Individuals were asked to complete the measure via a take-home questionnaire following Session 1. The MMM is used to assess the five main motives for using cannabis: enhancement (e.g., "because it gives me a pleasant feeling"), conformity (e.g., "so I won't feel left out"), expansion (e.g., "to expand my awareness"), social (e.g., "to celebrate a special occasion with friends"), and coping (e.g., "because it helps me when I feel depressed or nervous"). Respondents score items on

a 5-point scale ranging from 1 (*almost never/never*) to 5 (*almost always/always*; Simons et al., 1998). For the current study, only the four-item Coping subscale (possible score range: 4–20) and five-item Enhancement subscale (possible score range: 5–25) were utilized; subscale scores were calculated by summing relevant items. The MMM has shown good internal consistency (Cronbach's αs = .86–.93; Simons et al., 1998) and concurrent validity. In the present sample, Cronbach's alpha values were .87 and .88 for the Coping and Enhancement subscales, respectively.

Cannabis Craving

The 12-item MCQ-SF (Heishman et al., 2009) was used to assess subjective cannabis craving immediately following exposure to each cue. Respondents rate items on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*), with possible scores ranging from 12 to 84. The MCQ-SF has shown convergent validity with the full 47-item MCQ as well as acceptable-to-good internal consistency (Heishman et al., 2009). Participants responded based on their cannabis craving at the current moment immediately following each cue exposure. In the present study, internal consistency was excellent, Cronbach's α = .92.

Data Analysis

Analyses were run using SPSS (Version 25). There were no missing data for the main hypothesis tests. Linear regression was used to test our first hypothesis, that PTSD symptoms would predict cannabis craving in response to the trauma cue (*c*), which represents the total effect. Next, we used the Hayes (2017) SPSS PROCESS macro (Version 3.5) to test a parallel mediation model, with both motives as simultaneous mediators, via analyses of indirect effects with bootstrapped confidence intervals. As the main measures were collected at different time points (i.e., PTSD symptoms during the screening process, MMM between Sessions 1 and 2, and cannabis craving at Session 2), there was temporal separation, making mediation analysis appropriate. The MMM was administered between sessions to allow for this temporal separation between measures. In the mediation models, *a*1 and *a*2 were the pathways of PTSD symptoms to coping or enhancement motives, respectively, and *b*1 and *b*2 were the pathways of coping and enhancement motives, respectively, to trauma cue–elicited cannabis craving. The direct effect (*c'*) was the path from PTSD symptoms to trauma cue–elicited cannabis craving after accounting for the indirect effects through coping and enhancement motives. The indirect effect (*ab*) was the path from PTSD symptoms to trauma cue–elicited cannabis craving through the proposed mediator, coping or enhancement motives (Figure 1). A power calculation based on published data of mediation studies showed a sample size of 53 would allow for the detection of a medium effect for Path *a* (i.e., *d* ≥ .30) and a large effect for Path *b* (i.e., *d* ≥ .50) at a power of .8 using a bias-corrected bootstrap statistical method (Fritz & MacKinnon 2007). A medium effect of PTSD

symptom severity and cannabis coping motives (i.e., Path *a*1) has been found in previous studies (β = .36, R^2 = .13, Boden et al., 2013; ΔR^2 = .34, Bonn-Miller et al., 2007) and was considered an effect size that was likely to be clinically significant. We also ran supplemental sensitivity analyses to test the same mediation analysis while controlling for baseline cannabis craving (i.e., craving following the neutral cue). These were run as separate mediation models as well as a parallel mediation model.

Results

Descriptive Statistics

The mean scores and standard deviations for measures of PTSD symptoms, cannabis motives, and cannabis craving to each cue (i.e., baseline and trauma) can be found in Table 2. The mean participant PCL-5 score was above the established clinical cutoff score, with 60.8% of the sample scoring at or above the 33-point threshold indicating probable PTSD (see Table 2). For the CUDIT-R, 37.3% of the sample scored at or above the 13-point threshold for likely cannabis dependence (*M* = 11.73, *SD* = 5.14).
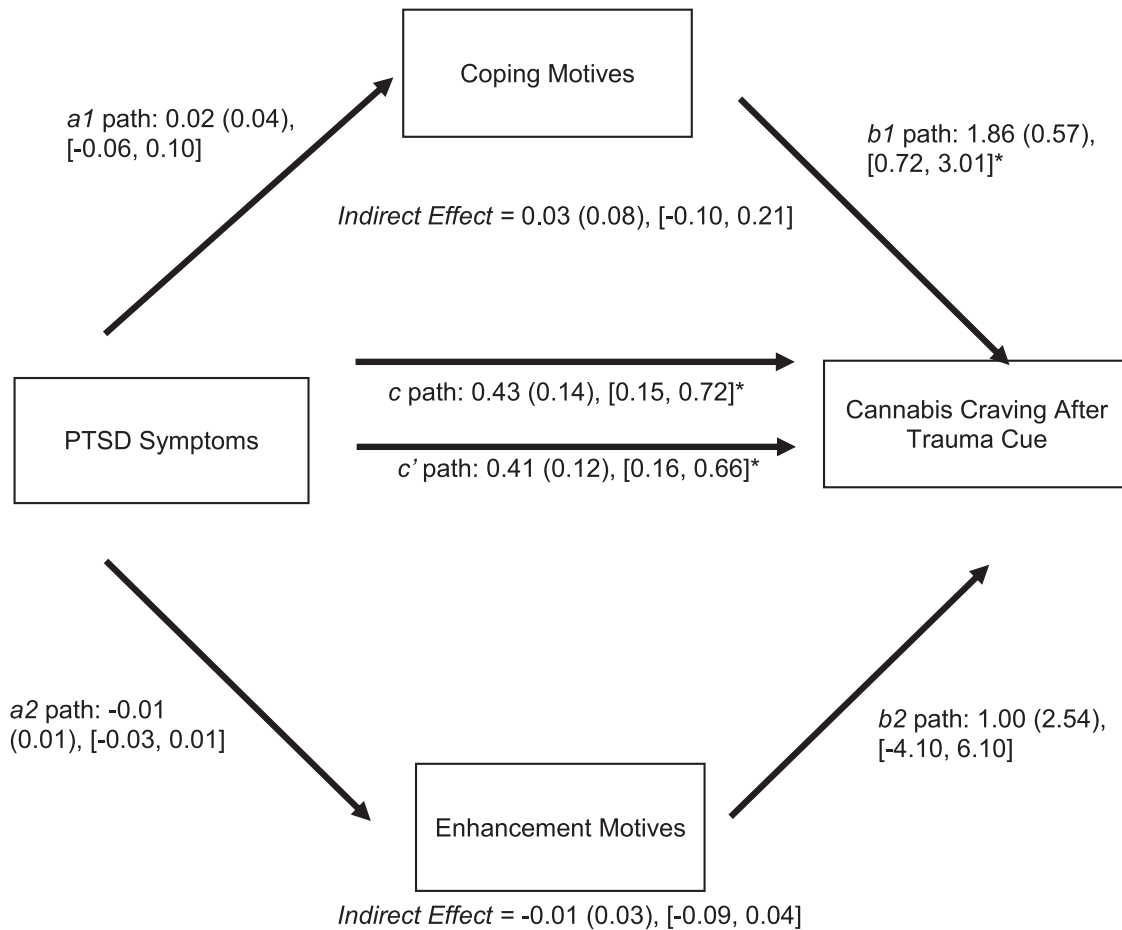
Hypothesis Tests

Consistent with our first hypothesis, the results of regression analyses demonstrated a significant positive effect of PTSD symptoms on the degree of trauma cue–elicited cannabis craving, *B* = 0.43, 95% CI [.15, .72], *p* = .004 (Figure 1). Partially consistent with our second hypothesis, there was no significant indirect effect through enhancement motives, indirect effect = −.01, *SE* = .03, 95% CI [−.09, .04] (Figure 1). However, inconsistent with this hypothesis, there was also no significant indirect effect through coping motives, indirect effect = .03, *SE* = .07, 95% CI [−.10, .21]. Neither the *a*1 pathway of PTSD symptoms to coping motives, *B* = 0.02, 95% CI [−0.06, 0.10], *p* = .665, R^2 < .00, *F*(1, 49) = 0.19, nor the *a*2 pathway of PTSD symptoms to enhancement motives was significant, *B* = −0.01, 95% CI [−0.03, 0.01], *p* = .421, R^2 = .01, *F*(1, 49) = 0.66. In addition, the *b*2 pathway of enhancement motives to trauma cue–elicited cannabis craving was not significant, *B* = 1.00, 95% CI [−4.10, 6.10], *p* = .695. There was, however, a significant effect for the *b*1 pathway of coping motives to trauma cue–elicited cannabis craving, *B* = 1.86, 95% CI [0.72, 3.01], *p* = .002. Together, PTSD and coping motives predicted a significant 42% of the variance in cannabis craving following trauma-cue exposure, R^2 = .42, *F*(3, 47) = 11.51, *p* < .001.

The main model findings held consistent in the supplemental mediation models with the two mediators entered separately after controlling for baseline cannabis craving (see Supplemental Figure S1) In the first of these two supplemental models, PTSD, coping motives, and baseline craving to the neutral cue predicted 65% of the variance in trauma cue–elicited cannabis craving. These findings also held largely consistent

Figure 1

Direct and Indirect Effect of Posttraumatic Stress Disorder (PTSD) Symptoms on Cannabis Craving Following a Personalized Trauma Cue, Through Coping and Enhancement Motives

Coping Motives

a1 path: 0.02 (0.04), [-0.06, 0.10]

b1 path: 1.86 (0.57), [0.72, 3.01]*

Indirect Effect = 0.03 (0.08), [-0.10, 0.21]

PTSD Symptoms

c path: 0.43 (0.14), [0.15, 0.72]*

Cannabis Craving After Trauma Cue

c' path: 0.41 (0.12), [0.16, 0.66]*

a2 path: -0.01 (0.01), [-0.03, 0.01]

b2 path: 1.00 (2.54), [-4.10, 6.10]

Enhancement Motives

Indirect Effect = -0.01 (0.03), [-0.09, 0.04]

Note. Unstandardized coefficients, standard errors, and 95% confidence intervals are shown. In significant paths, 95% confidence intervals do not include zero. *p < .05.

in the supplementary parallel mediation model with the two mediators entered simultaneously and controlled for baseline craving baseline (See Supplemental Figure S2). In this model,

Table 2

Mean Values and Standard Deviations of Model Variables

Variable	*M*	*SD*
PCL-5	36.04	16.61
MMM Coping	14.98	5.51
MMM Enhancement	16.67	5.22
MCQ_trauma[a]	47.57	18.18
MCQ_baseline[b]	39.45	16.61

Note. PCL-5 = Posttraumatic Stress Disorder Checklist Score; MMM = Marijuana Motives Measure; MMM Coping = MMM Coping subscale (four items); MMM Enhancement = MMM Enhancement scale (five items); MCQ = Marijuana Craving Questionnaire.
[a] Total MCQ score after the trauma cue. [b] Total baseline MCQ score after the baseline neutral cue.

PTSD remained a significant predictor, but the effect of coping motives to trauma cue–elicited cannabis craving was reduced to marginal significance, p = .062. This was likely due to the strong stability of the cannabis craving outcome (Supplemental Figure S2). In this model, 70% of the variance in trauma cue–elicited cannabis craving was explained by PTSD symptoms, coping motives, and cannabis craving to the neutral cue.

Discussion

The present study examined the association between PTSD symptoms and cannabis craving elicited by a personal trauma cue as well as cannabis coping motives as a potential mediator for this hypothesized link. We found a significant total effect of PTSD symptoms on trauma cue–elicited cannabis craving in a sample of trauma-exposed cannabis users, supporting our first hypothesis. Although we did not find evidence for cannabis coping motives as a mediator of the link between PTSD symptoms and trauma cue–elicited cannabis craving, there were

significant independent influences of both PTSD symptoms and cannabis coping motives on trauma cue–elicited cannabis craving.

The results extend previous findings of increased alcohol and cocaine craving in response to trauma- and substance-related cues among individuals suffering from PTSD and alcohol or cocaine use disorder (Coffey et al., 2002, 2006, 2010) to substance cravings related to trauma cues among trauma-exposed cannabis users. We also build on this prior work by showing that PTSD symptom severity and cannabis coping motives are independent predictors of trauma cue–elicited cannabis craving. Our finding is congruent with past self-report literature that has established a connection between PTSD symptom severity and cannabis craving during a quit attempt (Boden et al., 2013) and extends this to in-lab trauma cue–elicited craving. As PTSD is highly related to several adverse cannabis use outcomes (e.g., CUD, daily use; Cougle et al., 2011; Kevorkian et al., 2015), the present results are important, as they suggest that this association may be due to individuals with higher levels of PTSD symptom severity experiencing increased cannabis craving when they are exposed to reminders of their traumatic experience. These results have meaningful implications for understanding the role of PTSD in conditioned cannabis craving. The findings show that cannabis-using individuals with a history of trauma exposure respond to personalized trauma cues with cannabis craving and that PTSD symptom severity is related to the strength of this trauma cue–elicited cannabis craving. This suggests that it is not the trauma exposure itself but the consequences of the traumatic experience (i.e., PTSD symptoms) that are related to trauma cue–elicited cannabis craving.

We did not observe the hypothesized mediating role of cannabis coping motives in the association between PTSD symptoms and trauma cue–elicited craving; however, all paths were significant except the association between PTSD symptoms and cannabis coping and enhancement motives. Although some prior studies have shown an association, of moderate effect size, between PTSD symptoms and coping-motivated cannabis use (Boden et al., 2013; Bonn-Miller et al., 2007), the present results are consistent with other research that has not demonstrated significant associations between PSTD symptoms and coping motives for either cannabis use (Bonn-Miller et al., 2010) or alcohol use (Nishith et al., 2001). Part of this disparity could be due to unexamined moderators, such as sleep problems, that interact with PTSD symptoms to predict coping motives (Bonn-Miller et al., 2010; Nishith et al., 2001).

An important finding from the present study was the independent influence of coping-motivated cannabis use on trauma cue–elicited cannabis craving. This extends previous findings that have shown links between coping motives and craving (Farris et al., 2016). This is significant, as craving can have implications for substance relapse and withdrawal (Buckner et al., 2013). Coping motives may have been independently associated with cannabis craving to trauma cues because PTSD is not the only health consequence of trauma exposure: Anxiety, depression, and insomnia are other common sequelae (Ginzburg

et al., 2010; Pigeon et al., 2013). Thus, trauma-exposed individuals may be using cannabis to cope with other emotional consequences of trauma exposure in addition to PTSD. The independent association between coping motives and trauma cue-induced craving contrasts with the lack of an effect for enhancement motives, suggesting this relation between cannabis use to alter affective states and trauma cue–induced cannabis craving is specific to using cannabis to cope with general negative affect. This further highlights the potential negative consequences of coping motives on substance use outcomes (Bonn-Miller et al., 2007; Bujarski, Norberg, et al., 2012) in this case, the development of conditioned cannabis craving to personalized trauma cues.

Taken together, the independent effects of PTSD symptoms and general coping motives on cannabis craving in response to a personalized trauma cue explained a substantial amount of variance in trauma cue–elicited craving (i.e., 42% in our main model). This finding has important implications as it identifies two independent influences on conditioned cannabis craving, providing insight into whom should be targeted to prevent conditioned cannabis craving, such as individuals with elevated PTSD symptoms or coping-motivated cannabis users. The extant research has established the strong association between PTSD and substance use as well as the need for integrative treatment of PTSD and substance use comorbidities (e.g., Back et al., 2014). The present findings are consistent with this knowledge and build on the current understanding by indicating targets for treatment and the individuals to target to prevent the development of conditioned cannabis craving to trauma reminders.

Future studies could extend the present research by examining differences in the degree of trauma cue–elicited cannabis craving based on the patterns in which individuals use cannabis. Theoretically, if cannabis is used "as needed," such as to cope with negative affect following trauma reminder exposure, this could strengthen the association between trauma cues, cannabis use, and relief outcomes. In contrast, using cannabis at the same time each day rather than immediately in response to trauma cues could weaken these associations, thereby reducing or preventing the development of trauma-cue elicited cannabis craving. This kind of research could inform how medicinal cannabis should be prescribed for trauma-exposed individuals.

The present findings need to be considered in the context of several potential limitations. To start, the study had a relatively small sample size ($N = 51$). Previous studies that have reported links between PTSD and coping motives have had sample sizes of approximately 100 participants (Boden et al., 2013; Bonn-Miller et al., 2007) and have detected a medium effect size. Although a power calculation showed that our sample size was reasonable to detect a moderate effect (Fritz & MacKinnon, 2007), the *a*1 path of the association between PTSD symptoms and coping motives was particularly small in our sample. We would, therefore, have required an unrealistically large sample size to detect a small mediation effect of this size that would be statistically, but not clinically, significant (Fritz & MacKinnon,

2007). In another study that also failed to detect the association between PTSD symptoms and coping motives, the authors did demonstrate similarities to the present findings with a relatively small sample ($n = 20$) and similar mean participant age (M age $= 34$ years; Bonn-Miller et al., 2010). This could suggest sample differences between studies that detected an effect and those that did not. It should also be acknowledged that the temporal separation between the measures used in the present study was modest, and our data could therefore be considered more cross-sectional in nature. However, mediation has been established to be acceptable even for cross-sectional data where an indirect effect can still provide a meaningful first step toward identifying underlying mechanisms (Hayes, 2017). The lack of a mediation effect in our model could also be explained by an unexpected measurement bias. Specifically, the present study used a validated measure of coping motives that is not specific to coping with the symptoms of a specific psychological disorder. The general coping motives measure may have been too broad to reflect PTSD-specific coping as it assesses the use of cannabis to cope with many problems (e.g., to manage general feelings of depression or anxiety); as such, this could have diluted or underestimated the relation between PTSD symptoms and cannabis coping motives. A PTSD symptom–specific measure of coping motives might be used in future studies given the need to differentiate between cannabis use to cope with PTSD symptoms and use to cope with general negative affect (Bujarski, Feldner, et al., 2012). An example of a potential measure would be modifying the four-item Trauma Related Drinking to Cope scale (Hawn et al., 2020) for cannabis. Moreover, the study findings may lack generalizability due to the sample being composed predominately of White men. We also did not control for any other substance use disorder diagnoses or for the use of substances other than cannabis. Additionally, our characterization of likely rates of cannabis dependence and PTSD in the present sample was based on the use of established cutoff scores on self-report questionnaires rather than the use of clinical interviews. As we did not control for other mental health diagnoses, future research could also examine common PTSD comorbidities, such as PTSD–panic disorder or PTSD–depression, to examine if individuals are using cannabis to cope specifically with PTSD or with symptoms of other emotional disorders. Furthermore, a different craving measure could be used to help better differentiate between cannabis use to cope with negative affect and cannabis craving (e.g., the use of a visual analog craving scale asking about the current strength of one's desire, urge, or craving to use cannabis; Lundahl & Johanson, 2011), as the two measures we used involved some conceptual overlap, particularly between coping motives and items from the Emotionality and Expectancy subscales of our craving measure. Future research could also expand on the present study by including potential moderators of the associations between PTSD symptoms and cannabis coping motives (e g., sleep problems; Bonn-Miller et al., 2010; Nishith et al., 2001).

In summary, we found no evidence for general coping motives as a mediator for the hypothesized association between PTSD symptoms and trauma cue–elicited cannabis craving. However, the present result provides insight into the unique roles of PTSD symptoms and general coping motives in predicting cannabis craving following exposure to personalized trauma cues. The present findings support the need for integrative substance and PTSD treatment and provide insight to targets for preventing conditioned cannabis craving to trauma cues.

Open Practices Statement

This study was not formally preregistered. None of the data nor study materials are made available on a permanent third-party archive. Requests for data or materials should be sent via email to the corresponding author at sstewart@dal.ca .

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