

Examination of Rumination's Mediating Role in the Relation Between Distal Personality Predictors, Cannabis Coping Motives, and Negative Cannabis-Related Consequences

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ABSTRACT

Objective: Perseverative cognitive processes, such as rumination, may indirectly influence effects of personality traits on cannabis use and related problems. Understanding relations among personality, rumination, and cannabis use motives may lead to better understanding of problematic cannabis use. The present study examined personality traits' influence on negative cannabis-related consequences via rumination and cannabis use coping motives. **Methods:** We tested a sequential path model across two independent samples such that the model was tested in one sample and replicated in the second sample. Participants were U.S. undergraduate students from multiple universities who reported using cannabis at least once in the prior thirty days. **Results:** Results partially supported hypotheses such negative urgency and distress tolerance were indirectly related to negative cannabis-related consequences via rumination and coping motives. Specifically, higher negative urgency and lower distress tolerance were related to higher rumination. Higher rumination was related to higher coping motives; which in turn was related to more negative cannabis-related consequences. Results indicate that rumination is a risk factor belying associations between personality and cannabis use to cope and negative consequences of use. **Conclusions:** Implementing techniques that attenuate rumination for individuals high in negative urgency or low in distress tolerance may reduce or prevent problematic cannabis and unintended outcomes.

Key words: = sensation seeking; impulsivity; distress tolerance; emotion dysregulation; negative urgency

Cannabis use rates continue to rise in the United States (Center for Behavioral Health Statistics and Quality [SAHMSA], 2015; Hasin et al., 2015, Mauro et al., 2018). Additionally, higher cannabis potencies have paralleled the increase in use frequency (ElSohly et al., 2016), which amplifies the risk of experiencing harmful

outcomes (Brook et al., 2008; Hasin et al., 2015). Individuals who use cannabis are also more likely to experience downward social mobility and increased financial problems, as well as engage in more disruptive work-based behaviors (Cerdá et al., 2016; Trudeau et al., 2015). Those most at-risk for long-term cognitive impairment and negative

use consequences are youth (Jacobus & Tapert, 2015; Shrivastava et al., 2015) and emerging adults (SAHMSA, 2015; Wisk & Weitzman, 2016), particularly those enrolled in college (Meich et al., 2017). Given increases in prevalence, potency, and negative outcomes of cannabis use, identifying risk factors among adolescents and young adults is an important area of research and intervention.

Personality Traits as Predictors of Use and Consequences

Previous studies have established certain personality traits as distal antecedents of cannabis use and negative consequences of cannabis use (e.g., Dvorak & Day, 2014; Kentopp et al., 2019; Pearson et al., 2018). Such traits include sensation seeking, impulsivity, and emotion dysregulation. Sensation seeking is the desire for novel experiences and the willingness to take such risks (Conner, 2021). Impulsivity can be conceptualized via the UPPS-P five-factor model, which includes the factors of negative urgency (the tendency to act impulsively in response to negative emotions), lack of premeditation (acting without reflecting), lack of perseverance (not completing tasks), sensation seeking, and positive urgency (acting impulsively in response to positive emotions; Cyders et al., 2007; Whiteside & Lynam, 2001). Emotion dysregulation includes the inability to accept emotions, suppress emotion, problem-solve, redirect attention, or reappraise (Bonn-Miller et al., 2008). Related to emotion dysregulation is low distress tolerance, or a reduced coping threshold for negative emotions, which has been associated with coping motives for cannabis use (Semcho et al., 2016). Overall, these traits have robust relationships with increased cannabis use and undesirable use consequences (Brook, et al., 2016; Conner, 2021; Hayaki et al., 2011; Neugebauer et al., 2019; Pearson et al., 2018; Rinehart & Spencer, 2021; VanderVeen et al., 2016). Further, negative consequences of use often exacerbate cannabis use (Day et al., 2013; Martin-Santos et al., 2017).

In addition to these relationships, previous research highlights the importance of considering differential pathways between personality traits and cannabis use and unintended outcomes of use. For example, one study distinguished between traits comprising behavioral self-regulation, such as sensation seeking and self-control, and emotion

self-regulation, including distress tolerance and emotional instability (Dvorak & Day, 2014). Behavioral self-regulation was associated with increased cannabis use, while emotional self-regulation and urgency were associated with increased cannabis use problems. Because of the differential paths from personality traits to cannabis use and unintended outcomes of use, further exploration of distinct variables that influence (i.e., mediate) these relationships may inform clinical invention (Dvorak & Day, 2014).

Rumination

Perseverative cognitive processes, such as rumination, may influence the effects of personality traits on cannabis use and related problems. Response Styles Theory defines rumination as a preoccupation on symptoms of distress that interferes with solving the problem causing the distress (Nolen-Hoeksema, 2012). Rumination not only fails to down-regulate, but actively prolongs and exacerbates the experiencing of the negative emotion. It is the tendency to focus repetitively on the symptoms of emotional stress, as well as the potential meaning, causes, and consequences of the symptoms, without solving the contributing problems (i.e., it is a focus on the problem, as opposed to solutions; Nolen-Hoeksema & Jackson, 2001). Multiple theories postulate rumination to comprise mechanisms of brooding, reflection, and emotional self-awareness (Johnson & Whisman, 2013; Nolen-Hoeksema, 2012). In support of negative affect models (e.g., Baker et al., 2004), rumination mediates relations between negative affect and cannabis motives and consequences (Bravo et al., 2019). However, research examining the mediating role of rumination in linking personality traits to cannabis motives and outcomes is limited.

Personality and Rumination

While research has established links between personality and cannabis consequences (e.g., Dvorak & Day, 2014; Kentopp et al., 2019; Pearson et al., 2018), the pathway is not expressly understood, and, given that personality is difficult to change (Wagner et al., 2020), this information does not inform effective interventions to stop individuals from experiencing these

consequences. Personality first forms during childhood, solidifies in adolescence and young adulthood, and typically remains stable across the rest of the lifespan. Thus, personality is a fairly static variable that provides boundaries for potential behavioral responses (Robinson et al., 2019). Cognitive processes, such as rumination, likely play a role in determining how personality traits influence behavior in the moment. Having a better understanding of the mechanisms through which specific personality traits influence motives, behavior and outcomes will identify leverage points for intervention to disrupt the link between personality and consequences. In other words, it is quite difficult to change personality. So, if intermediate steps that can be addressed, in this case rumination, can be identified, then effective interventions to lower the probability of experiencing negative health outcomes, such as negative consequences from cannabis use, can be identified and changed. For instance, individuals who score high on impulsivity due to their inability to tolerate negative affect (i.e., negative urgency) and who also tend to ruminate may use cannabis as a coping motive to stop ruminating, and thus may increase their chances of experiencing negative cannabis consequences.

Present Study

The present study examined personality traits' influence on negative cannabis-related consequences via rumination and cannabis use coping motives. Specifically, we examined a sequential mediation model such that personality factors (i.e., impulsivity, sensation seeking, distress tolerance, and emotion regulation facets) would associate with rumination. In turn, higher rumination would be associated with higher endorsement of cannabis coping motives, which would be associated with more negative cannabis-related consequences. Given that the field of psychology is currently undergoing a rather strong indictment regarding effects that are not reproducible (e.g., Simmons et al., 2011), we examined the proposed comprehensive model across two independent samples of college students (Project CMS, Project SNAP). Specifically, we first tested the comprehensive model in the Project CMS sample and based on results of the model, we then trimmed the model (i.e., removed non-significant direct effects [but

kept those variables in as covariates]) and examined if significant results replicated within the Project SNAP sample (as well as tested for model fit).

METHODS

Participants/Procedures

Project CMS Sample

The participant sample for this present study was comprised of college students from eight universities across five countries (the U.S., Spain, Argentina, Uruguay, and the Netherlands). Participants completed an online survey exploring risk and protective factors of cannabis use and subsequent outcomes (for more information, see Bravo et al., 2019). Due to the design of the parent study, several constructs (i.e., distress tolerance, emotion regulation) assessed in the present study were only collected at the U.S. institutions. Given the aims of the present study, the analytic sample was limited to 698 students across multiple U.S. universities located in four states (Colorado, New Mexico, New York, Virginia) who reported using cannabis at least once in the past 30 days. The majority of participants identified as being non-Hispanic White (60.2%), female (64.5%), freshman (53.9%) and reported a mean age of 19.53 (Median = 19.00; $SD = 2.72$) years. Study procedures were approved by the institutional review boards for each participating university.

Project SNAP Sample

Participants were college students recruited to participate in an online survey (standardized across sites) from psychology department research participant pools at seven universities across six U.S. states (Colorado, New Mexico, New York, Virginia [2 sites], Texas, and Wyoming) between Fall 2019 and Spring 2020 (for more information, see Looby et al., 2021). Given the aims of the present study, the analytic sample was limited to 1,447 students who reported using cannabis at least once in the past 30 days. The majority of participants identified as being non-Hispanic White (47.6%), female (69.7%), freshman (48.6%) and reported a mean age of 19.61 (Median = 19.00; $SD = 2.55$) years. This study was

conducted after receiving single-site IRB approval.

Measures

For all measures (unless specified), composite scores were created by first reverse-coding items when appropriate such that higher scores indicate higher levels of the construct and then averaging across items. All measures (except for coping cannabis motives) were assessed in both Project CMS and Project SNAP samples.

Distress Tolerance

Distress tolerance was assessed using the 15-item Distress Tolerance Scale (Simons & Gaher, 2005). The items measure participants' expectations and evaluations of negative emotional states along four dimensions that constitute the meta-emotion construct of distress tolerance, namely: tolerance, appraisal, absorption, and regulation of negative emotional states. Participants respond to items using a 5-point Likert response scale (1 = Strongly agree, 5 = Strongly disagree). The total score was found to be internally consistent across both samples (Project CMS Sample, $\alpha = .94$; Project SNAP sample, $\alpha = .93$).

Impulsivity

Positive urgency, negative urgency, premeditation, and perseverance were assessed as facets of impulsivity, using the 20-item Short UPPS-P Impulsive Behavior Scale (Cyders et al. 2014). Participants respond to items using a 4-point Likert response scale (1 = Agree strongly, 2 = Agree some, 3 = Disagree some, and 4 = Disagree strongly). Reliability for the current study was excellent: Positive urgency (Project CMS Sample, $\alpha = .89$; Project SNAP sample, $\alpha = .89$), negative urgency (Project CMS Sample, $\alpha = .86$; Project SNAP sample, $\alpha = .82$), premeditation (Project CMS Sample, $\alpha = .90$; Project SNAP sample, $\alpha = .88$), and perseverance (Project CMS Sample, $\alpha = .82$; Project SNAP sample, $\alpha = .83$). Note that a separate scale was used to assess sensation seeking, so the sensation seeking subscale of the SUPPS-P was not used in the present study.

Sensation Seeking

The Sensation Seeking Personality Trait Scale (Conner, 2021) was used to assess experience seeking (the desire for novel experiences) and risk seeking (the willingness to take risks for those experiences). Sample items from the experience seeking subscale include: "I think it is important to try as many new things as I can" and "I like to experience anything and everything I can," whereas sample items from the risk seeking subscale include: "I think that excitement is more important than safety" and "I enjoy participating in unsafe activities." Experience seeking (Project CMS Sample, $\alpha = .83$; Project SNAP sample, $\alpha = .80$) and risk seeking (Project CMS Sample, $\alpha = .86$; Project SNAP sample, $\alpha = .80$) exhibited good internal consistency in the present study.

Emotion Regulation

Emotion regulation was assessed using the 10-item Emotion Regulation Questionnaire (Gross & John, 2003), a self-report measure assessing use of cognitive reappraisal and expressive suppression as emotion regulatory strategies. Reliability for the current study was acceptable-excellent: Cognitive Reappraisal (Project CMS Sample, $\alpha = .92$; Project SNAP sample, $\alpha = .91$) and Emotional Suppression (Project CMS Sample, $\alpha = .76$; Project SNAP sample, $\alpha = .73$).

Rumination

Rumination was assessed using the Ruminative Thought Style Questionnaire (RTSQ; Brinker & Dozois, 2009). This measure assesses participants' overall tendency toward ruminative thinking via self-report. It comprises 20-items and uses a 7-point response scale (1 = Not at all, 7 = Very Well). Reliability for the current study was excellent: Project CMS Sample, ($\alpha = .95$); Project SNAP sample, ($\alpha = .95$).

Cannabis Coping Motives

In Project CMS, the Marijuana Motives Measure Short Form (MMM-SF, Simons et al, 1998) was used to assess coping cannabis motives ($\alpha = .89$). In Project SNAP, the Comprehensive Marijuana Motives Questionnaire (Lee et al.,

2009) was used to assess cannabis coping motives ($\alpha = .84$).

Cannabis Use and Consequences

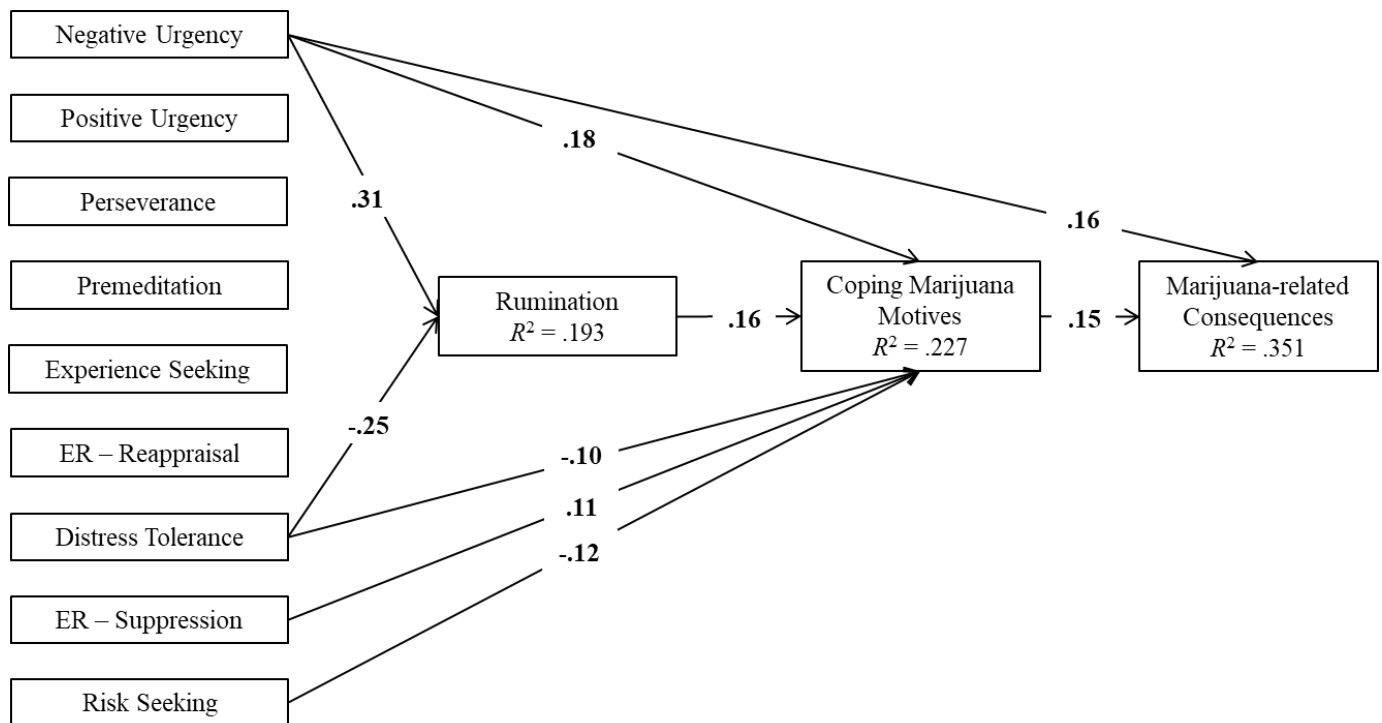
Typical cannabis use frequency and quantity (covariates in our models) were assessed using the Marijuana Use Grid (Pearson & Marijuana Outcomes Study Team, 2021). Specifically, each day of the week was broken into six 4-hour blocks of time (12a-4a, 4a-8a, 8a-12p, etc.), and participants were asked to report at which times they used cannabis during a “typical week” in the past 30 days, as well as the quantity of grams consumed during that time block. We calculated typical frequency of cannabis use by summing the total number of time blocks for which they reported using during the typical week (ranges: 0-42). We calculated typical quantity of cannabis use by summing the total number of grams

consumed across time blocks during the typical week (quantity estimates >3 SDs above the mean were Winsorized). Negative cannabis-related consequences were assessed using the 21-item Brief Marijuana Consequences Questionnaire (Simons et al., 2012). Answers to specific items are summed across facets for a single consequence score. Reliability for the current study was as follows: Project CMS Sample, ($\alpha = .87$); Project SNAP sample, ($\alpha = .89$).

Statistical Analyses

To test the study aims, a fully saturated path model (see Figure 1) in which personality variables were modeled as predictors of negative cannabis-related consequences via rumination and cannabis coping motives was estimated using Mplus 8.3 (Muthén & Muthén, 1998-2017) within the CMS sample.

Figure 1. Significant standardized direct effects of the comprehensive mediation model in Project CMS sample.



Note. The covariances among distal antecedents and effects of covariates (i.e., marijuana use frequency, marijuana use quantity, social motives, enhancement motives, conformity motives, and expansion motives) are not depicted for parsimony but are available upon request. Significant associations were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero.

Within this model, cannabis use frequency, cannabis use quantity, social motives, enhancement motives, conformity motives, and expansion motives were entered as covariates. Based on results of the model tested in Project CMS sample, we then trimmed the model (i.e., removed non-significant direct effects but kept variables as covariates) and examined if significant results replicated within the Project SNAP sample (as well as tested for model fit to determine if the trimmed model was adequate) using Mplus 8.3 (Muthén & Muthén, 1998-2017).

For both models, missing data were handled using full information maximum likelihood (Muthén & Muthén, 1998-2017). We examined the total, direct, and indirect effects using bias-corrected bootstrapped estimates (Efron &

Tibshirani, 1993), which provides a powerful test of mediation (Fritz & MacKinnon, 2007) and is robust to small departures from normality (Erceg-Hurn & Mirosevich, 2008). Statistical significance was determined by 99% bias-corrected bootstrapped confidence intervals not containing zero in both models.

RESULTS

Comprehensive Mediation Model in Project CMS

Bivariate correlations and descriptive statistics of study variables in Project CMS are presented in Table 1.

Table 1. *Bivariate correlations of variables in the mediation model in Project CMS sample.*

	1	2	3	4	5	6	7	8	9	10	11	12	<i>M</i>	<i>SD</i>
1. Distress Tolerance	---												3.22	0.81
2. Negative Urgency	-.35	---											2.09	0.78
3. Positive Urgency	-.22	.54	---										1.88	0.75
4. Perseverance	-.05	.08	-.05	---									3.08	0.66
5. Premeditation	.06	-.22	-.20	.41	---								3.12	0.73
6. Risk Seeking	.04	.14	.34	-.06	-.28	---							2.89	0.72
7. Experience Seeking	.21	-.15	-.05	.20	.06	.42	---						3.58	0.58
8. ER – Reappraisal	.27	-.18	-.11	.14	.19	-.07	.26	---					4.70	1.12
9. ER – Suppression	-.13	.12	.20	-.03	-.05	.10	.00	.26	---				4.11	1.26
10. Rumination	-.33	.37	.15	.10	-.11	.00	-.04	-.04	.12	---			4.11	1.30
11. Coping Marijuana Motives	-.25	.32	.16	-.03	-.12	-.02	-.12	-.05	.17	.28	---		2.29	1.24
12. Marijuana Consequences	-.11	.22	.09	-.02	-.12	.07	-.06	-.02	.01	.14	.28	---	3.51	4.01

Note. Significant correlations are bolded and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. ER = Emotion Regulation. Correlations with covariates (i.e., marijuana use frequency, marijuana use quantity, social motives, enhancement motives, conformity motives, and expansion motives) are available upon request.

The total, total indirect, specific indirect, and direct effects of the comprehensive mediation model are summarized in Table 2 and Figure 1. Within the model, only distress tolerance (negative association) and negative urgency (positive association) were significantly associated with rumination after controlling for effects of other personality predictors and covariates. Several personality variables and rumination were significantly directly associated with cannabis coping motives: distress tolerance

(negative association), negative urgency (positive association), risk seeking (negative association), emotion regulation - suppression facet (positive association), and rumination (positive association). Negative urgency (positive association) and cannabis coping motives (positive association) were the only variables significantly associated with negative cannabis-related consequences after controlling for effects of all other variables.

Table 2. Summary of total, indirect, and direct effects of distal antecedences, rumination, and marijuana coping motives on negative marijuana-related consequences in a comprehensive mediation model in Project CMS sample.

Outcome Variables	Rumination		Coping Marijuana Motives		Negative Marijuana-related Consequences	
	β	95% CI	β	95% CI	β	95% CI
Predictor Variable: <i>Distress Tolerance</i>						
Total	-0.245	-0.36, -0.13	-0.136	-0.23, -0.05	-0.056	-0.16, 0.04
Total indirect ^a	---	---	-0.039	-0.07, -0.02	-0.036	-0.08, 0.000
Specific indirect:						
Rumination	---	---	-0.039	-0.07, -0.02	-0.015	-0.05, 0.02
Coping Marijuana Motives	---	---	---	---	-0.015	-0.04, -0.001
Rumination → Coping Marijuana Motives	---	---	---	---	-0.006	-0.02, -0.002
Direct	-0.245	-0.36, -0.13	-0.097	-0.19, -0.001	-0.020	-0.13, 0.08
Predictor Variable: <i>Negative Urgency</i>						
Total	.307	0.19, 0.43	.230	0.12, 0.34	.210	0.10, 0.32
Total indirect ^a	---	---	.049	0.02, 0.09	.054	0.01, 0.11
Specific indirect:						
Rumination	---	---	.049	0.02, 0.09	.019	-0.02, 0.06
Coping Marijuana Motives	---	---	---	---	.028	0.01, 0.06
Rumination → Coping Marijuana Motives	---	---	---	---	.008	0.002, 0.02
Direct	.307	0.19, 0.43	.181	0.08, 0.29	.156	0.04, 0.28
Predictor Variable: <i>Positive Urgency</i>						
Total	-0.060	-0.20, 0.07	-0.026	-0.13, 0.08	-0.053	-0.17, 0.07
Total indirect ^a	---	---	-0.010	-0.04, 0.01	-0.008	-0.03, 0.01
Specific indirect:						
Rumination	---	---	-0.010	-0.04, 0.01	-0.004	-0.03, 0.004
Coping Marijuana Motives	---	---	---	---	-0.002	-0.02, 0.02
Rumination → Coping Marijuana Motives	---	---	---	---	-0.001	-0.01, 0.001
Direct	-0.060	-0.20, 0.07	-0.016	-0.12, 0.09	-0.045	-0.17, 0.07
Predictor Variable: <i>Perseverance</i>						
Total	.074	-0.04, 0.19	.005	-0.09, 0.09	.033	-0.07, 0.13
Total indirect ^a	---	---	.012	-0.01, 0.04	.005	-0.01, 0.03
Specific indirect:						
Rumination	---	---	.012	-0.01, 0.04	.005	-0.004, 0.03
Coping Marijuana Motives	---	---	---	---	-0.001	-0.02, 0.01
Rumination → Coping Marijuana Motives	---	---	---	---	.002	-0.001, 0.01
Direct	.074	-0.04, 0.19	-0.007	-0.10, 0.08	.027	-0.07, 0.13
Predictor Variable: <i>Premeditation</i>						
Total	-0.110	-0.23, 0.01	-0.051	-0.14, 0.04	-0.039	-0.15, 0.07
Total indirect ^a	---	---	-0.018	-0.05, 0.001	-0.015	-0.05, 0.004
Specific indirect:						
Rumination	---	---	-0.018	-0.05, 0.001	-0.007	-0.03, 0.01
Coping Marijuana Motives	---	---	---	---	-0.005	-0.03, 0.01
Rumination → Coping Marijuana Motives	---	---	---	---	-0.003	-0.01, 0.000
Direct	-0.110	-0.23, 0.01	-0.034	-0.13, 0.06	-0.024	-0.13, 0.08
Predictor Variable: <i>Risk Seeking</i>						
Total						
Total indirect ^a						
Specific indirect:						
Rumination						
Coping Marijuana Motives						
Rumination → Coping Marijuana Motives						
Direct						

Total	-.053	-0.17, 0.06	-.126	-0.24, -0.01	.052	-0.06, 0.16
Total indirect ^a	---	---	-.009	-0.03, 0.01	-.023	-0.06, -0.002
Specific indirect:						
Rumination	---	---	-.009	-0.03, 0.01	-.003	-0.02, 0.004
Coping Marijuana Motives	---	---	---	---	-.018	-0.05, -0.002
Rumination → Coping Marijuana Motives	---	---	---	---	-.001	-0.01, 0.001
Direct	-.053	-0.17, 0.06	-.117	-0.23, -0.01	.075	-0.04, 0.19
Predictor Variable: <i>Experience Seeking</i>	β	95% CI	β	95% CI	β	95% CI
Total	.044	-0.07, 0.17	.013	-0.09, 0.13	-.042	-0.15, 0.08
Total indirect ^a	---	---	.007	-0.01, 0.03	.005	-0.02, 0.03
Specific indirect:						
Rumination	---	---	.007	-0.01, 0.03	.003	-0.004, 0.02
Coping Marijuana Motives	---	---	---	---	.001	-0.02, 0.02
Rumination → Coping Marijuana Motives	---	---	---	---	.001	-0.002, 0.01
Direct	.044	-0.07, 0.17	.006	-0.10, 0.12	-.046	-0.16, 0.07
Predictor Variable: <i>ERQ – Reappraisal</i>	β	95% CI	β	95% CI	β	95% CI
Total	.048	-0.07, 0.17	-.030	-0.12, 0.07	.064	-0.04, 0.16
Total indirect ^a	---	---	.008	-0.01, 0.03	-.002	-0.02, 0.02
Specific indirect:						
Rumination	---	---	.008	-0.01, 0.03	.003	-0.004, 0.02
Coping Marijuana Motives	---	---	---	---	-.006	-0.03, 0.01
Rumination → Coping Marijuana Motives	---	---	---	---	.001	-0.002, 0.01
Direct	.048	-0.07, 0.17	-.038	-0.13, 0.06	.066	-0.04, 0.16
Predictor Variable: <i>ERQ – Suppression</i>	β	95% CI	β	95% CI	β	95% CI
Total	.053	-0.05, 0.17	.115	0.03, 0.20	-.060	-0.16, 0.03
Total indirect ^a	---	---	.008	-0.01, 0.03	.021	0.004, 0.05
Specific indirect:						
Rumination	---	---	.008	-0.01, 0.03	.003	-0.004, 0.02
Coping Marijuana Motives	---	---	---	---	.016	0.003, 0.04
Rumination → Coping Marijuana Motives	---	---	---	---	.001	-0.001, 0.01
Direct	.053	-0.05, 0.17	.107	0.02, 0.20	-.081	-0.18, 0.01
Predictor Variable: <i>Rumination</i>	β	95% CI	β	95% CI	β	95% CI
Total	---	---	.160	0.07, 0.25	.085	-0.04, 0.20
Indirect effect via Coping Marijuana Motives	---	---	---	---	.025	0.01, 0.05
Direct	---	---	.160	0.07, 0.25	.061	-0.06, 0.18

Note. Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. ^a Reflects the combined indirect associations within the model. Within the model, Coping Marijuana Motives was significantly positively associated with Negative Marijuana-related Consequences ($\beta = .15$). Effects of covariates (i.e., marijuana use frequency, marijuana use quantity, social motives, enhancement motives, conformity motives, and expansion motives) are available upon request.

As expected based on the direct effects, only negative urgency and distress tolerance were indirectly related to negative cannabis-related consequences via rumination and coping motives. Specifically, higher negative urgency and lower distress tolerance were related to higher rumination. Higher rumination was in turn related to higher coping motives, which in turn was related to more negative cannabis-related consequences. It is important to note that cannabis coping motives uniquely statistically significantly mediated the associations between

both risk seeking and distress tolerance and negative cannabis-related consequences (both negative indirect effects), as well as between both negative urgency and emotion regulation (suppression facet) and negative cannabis-related consequences (both positive indirect effects).

Replication Mediation Model in Project SNAP

Bivariate correlations and descriptive statistics of study variables in Project SNAP are presented in Table 3.

Table 3. *Bivariate correlations of variables in the mediation model in Project SNAP sample.*

	1	2	3	4	5	6	7	8	9	10	11	12	<i>M</i>	<i>SD</i>
1. Distress Tolerance	---												3.10	0.83
2. Negative Urgency		---											2.24	0.77
3. Positive Urgency	-.25	.45	---										2.04	0.79
4. Perseverance	-.07	.10	-.05	---									3.04	0.67
5. Premeditation	-.01	-.16	-.11	.53	---								3.11	0.63
6. Risk Seeking	-.01	.17	.40	-.13	-.24	---							2.82	0.66
7. Experience Seeking	.12	-.15	-.03	.17	.10	.38	---						3.45	0.58
8. ER – Reappraisal	.33	-.34	-.14	.17	.24	-.02	.30	---					4.55	1.26
9. ER – Suppression	.01	-.02	.04	-.05	-.00	.03	.01	.28	---				4.05	1.34
10. Rumination	-.26	.25	-.00	.15	-.06	.06	.14	.05	.24	---			4.53	1.28
11. Coping Marijuana Motives	-.31	.29	.22	-.05	-.13	.18	-.04	-.11	.18	.24	---		2.29	1.19
12. Marijuana Consequences	-.14	.19	.18	-.07	-.14	.17	-.05	-.02	.08	.13	.40	---	4.27	4.59

Note. Significant correlations are bolded and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. ER = Emotion Regulation. Correlations with covariates (i.e., marijuana use frequency and marijuana use quantity) are available upon request.

Based on the results of the model tested in the Project CMS sample, we trimmed the model for Project SNAP such that only significant direct effects found in Project CMS (see Figure 1) were entered as predictors of the mediation effects (all other variables were entered as covariates) in the replication model. It is important to note that other motives were assessed but not included in the replication mediation model, given

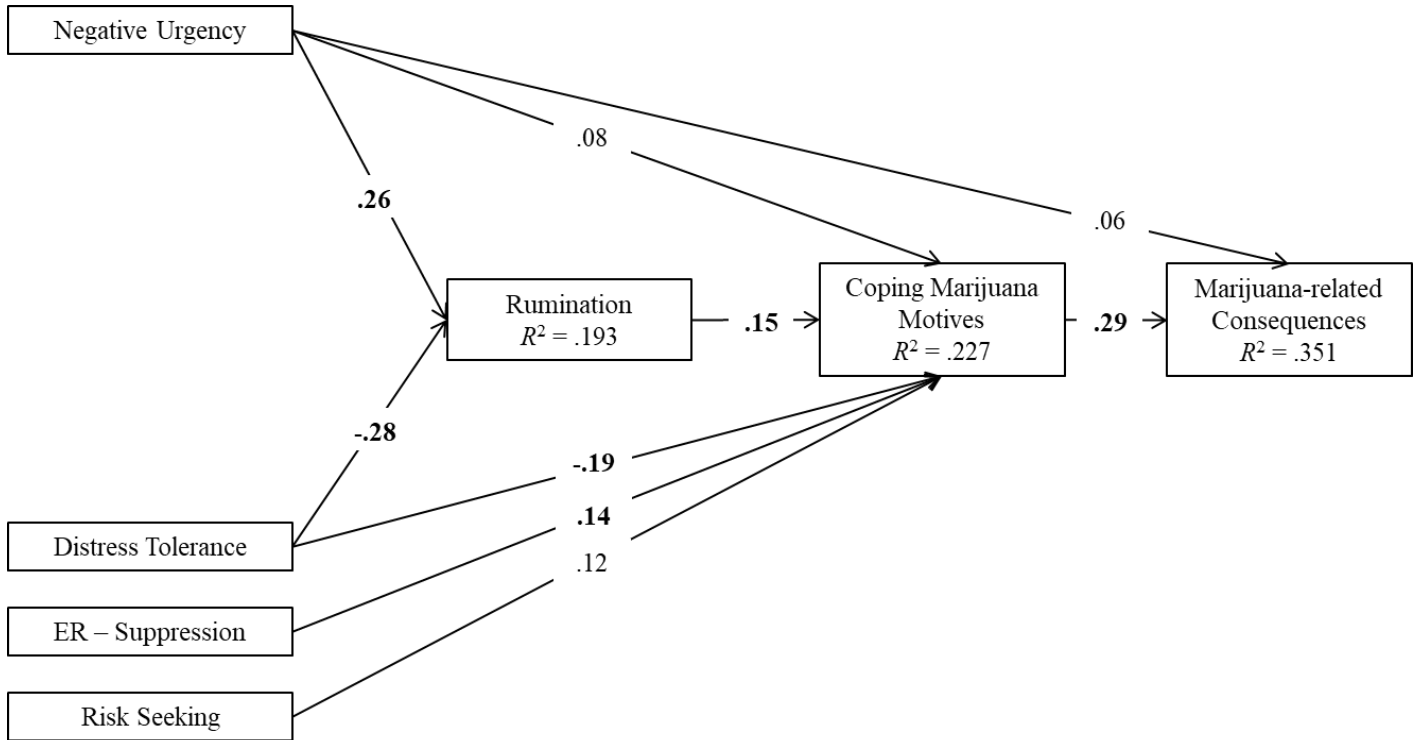
discrepancies across cannabis motives measures. The replication mediation model provided an acceptable fit to the data based on most fit indices (Hu & Bentler, 1999), CFI=.987, RMSEA=.045, 90% CI [.026, .064], SRMR=.019. The total, total indirect, specific indirect, and direct effects of the replication mediation model in Project SNAP are summarized in Table 4 and Figure 2.

Table 4. Summary of total, indirect, and direct effects of distal antecedences, rumination, and marijuana coping motives on negative marijuana-related consequences in replication mediation model in Project SNAP sample.

Outcome Variables	<i>Rumination</i>		<i>Coping Marijuana Motives</i>		<i>Negative Marijuana-related Consequences</i>	
	<i>B</i>	<i>95% CI</i>	<i>B</i>	<i>95% CI</i>	<i>B</i>	<i>95% CI</i>
Predictor Variable: <i>Distress Tolerance</i>						
Total	-.278	-0.49, -0.05	-.234	-0.35, -0.11	---	---
Total indirect ^a	---	---	-.041	-0.10, -0.004	-.067	-0.11, -0.03
Specific indirect:						
Rumination	---	---	-.041	-0.10, 0.004	---	---
Coping Marijuana Motives	---	---	---	---	-.056	-0.10, -0.02
Rumination → Coping Marijuana Motives	---	---	---	---	-.012	-0.03, -0.001
Direct	-.278	-0.49, -0.05	-.193	-0.32, -0.05	---	---
Predictor Variable: <i>Negative Urgency</i>						
Total	.263	0.03, 0.49	.120	-0.01, 0.24	.090	-0.03, 0.21
Total indirect ^a	---	---	.039	0.002, 0.11	.034	-0.003, 0.07
Specific indirect:						
Rumination	---	---	.039	0.002, 0.11	---	---
Coping Marijuana Motives	---	---	---	---	.023	-0.02, 0.07
Rumination → Coping Marijuana Motives	---	---	---	---	.011	0.001, 0.03
Direct	.263	0.03, 0.49	.081	-0.06, 0.22	.055	-0.06, 0.17
Predictor Variable: <i>Risk Seeking</i>						
Total	---	---	.121	-0.03, 0.26	---	---
Total indirect ^a	---	---	---	---	---	---
Specific indirect:						
Rumination	---	---	---	---	---	---
Coping Marijuana Motives	---	---	---	---	.035	-0.01, 0.08
Rumination → Coping Marijuana Motives	---	---	---	---	---	---
Direct	---	---	.121	-0.03, 0.26	---	---
Predictor Variable: <i>ERQ – Suppression</i>						
Total	---	---	.143	0.04, 0.25	---	---
Total indirect ^a	---	---	---	---	---	---
Specific indirect:						
Rumination	---	---	---	---	---	---
Coping Marijuana Motives	---	---	---	---	.041	0.01, 0.07
Rumination → Coping Marijuana Motives	---	---	---	---	---	---
Direct	---	---	.143	0.04, 0.25	---	---
Predictor Variable: <i>Rumination</i>						
Total	---	---	.148	0.01, 0.27	---	---
Indirect effect via Coping Marijuana Motives	---	---	---	---	.043	0.002, 0.09
Direct	---	---	.148	0.01, 0.27	---	---

Note. Significant associations are in bold typeface for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. ^a Reflects the combined indirect associations within the model. Within the model, Coping Marijuana Motives was significantly positively associated with Negative Marijuana-related Consequences ($\beta = .29$). Effects of covariates (i.e., marijuana use frequency, marijuana use quantity, positive urgency, perseverance, premeditation, experience seeking, and emotion regulation - reappraisal) are available upon request.

Figure 2. Standardized direct effects of the replication mediation model in Project SNAP sample.



Note. Depicts the standardized direct effects of the replication mediation model in Project SNAP sample. The covariances among distal antecedents and effects of covariates (i.e., marijuana use frequency, marijuana use quantity, positive urgency, perseverance, premeditation, experience seeking, and emotion regulation - reappraisal) are not depicted for parsimony but are available upon request. Significant associations are in bold and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero.

Findings in the replication mediation model in Project SNAP largely replicated findings from the comprehensive mediation model in Project CMS. Specifically, rumination was indirectly associated with more negative cannabis-related consequences via higher cannabis coping motives (even when using a different measure of cannabis coping motives). Regarding indirect effects of distress tolerance and negative urgency on negative cannabis-related consequences, findings were consistent with those found in Project CMS. Specifically, higher negative urgency and lower distress tolerance were associated with more negative cannabis-related consequences via higher rumination and higher coping motives. The significant indirect effects of negative urgency and risk seeking on negative cannabis-related consequences via cannabis coping motives did not replicate between Project CMS and Project SNAP. However, the indirect effects of emotion regulation (suppression facet) and low distress

tolerance via cannabis coping motives did replicate across samples.

DISCUSSION

Past research indicates that cognitive processes (such as cannabis refusal self-efficacy, cognitive reappraisal of emotions, and premeditation) are strategies effectually moderating predictive associations between high-risk traits, coping use motives, and negative use consequences (Bonn-Miller et al., 2008; Brook et al., 2016; Cerdá et al., 2016; Dvorak & Day, 2014; Kentopp et al., 2019; Pearson et al., 2018; Prosek et al., 2018; VanderVeen, 2016). Given this, we sought to further understand the potential effect of rumination (as a form of cognitive processing), potentially linking the associations between distal predictors, cannabis coping motives, and negative use consequences. Our results across two independent samples were consistent with our hypotheses, in that we found that rumination is a

risk factor belying associations between personality (particularly distress tolerance and negative urgency) and cannabis use to cope and negative consequences of use.

A possible explanation for these results might lie in sense of engaged-avoidance caused by low distress tolerance and negative urgency. The inability to cope with negative emotional states and the likelihood of having a rash behavioral reaction simultaneously express a need to avoid and a need to engage. Cognitive and emotional processes that increase distress tolerance, reduce negative urgency, and are associated with reduction in substance use and use-related problems (Aldao et al., 2010; Cooper et al., 1988; Hayaki et al., 2011; Lynch, et al., 2007) require engagement with the problem at hand and appraisal of the distress it's causing. Rumination, however, mimics the sense of engagement in this dynamic but redirects it towards distress, avoiding the problem. Circumventing the problem leads to a positive feedback loop of engaged-avoidance, where the problem is not reduced and distress from the problem is exacerbated. This redirection away from the problem towards fixation on the distress may act in tension with the need to alleviate the distress, which may lead individuals to seek alternative (maladaptive) coping strategies such as using cannabis.

Clinical Implications

Results of the current study imply that interventive techniques targeted to disrupt ruminative mechanisms in individuals with increased negative urgency and lower distress tolerance may disrupt pathways to negative cannabis use consequences via decreasing use of cannabis to cope. Put conversely, the implication is that individuals with low distress tolerance and higher negative urgency are more likely to engage in rumination, which encourages the likelihood of using cannabis to cope with ruminative thoughts and, in turn, experience negative consequences from use. Research on alcohol use suggests personality-targeting interventions can manage high-risk traits with regard to drinking-to cope (Conrod et al., 2006), but this line of thinking has been less documented with regard to cannabis use. Although preliminary, our results support the empirical pursuit of interventions targeting high-risk trait management as a disruption of

pathways leading to negative cannabis use consequences. Specifically, our results suggest that individuals, screened for low distress tolerance and higher negative urgency, may benefit from interventions designed to replace rumination with cognitive processes such as reappraisal, refusal self-efficacy, and premeditation.

Due to the preliminary nature of this study, rumination was considered as a single-factor construct in order to retain focused scope. Further empirical work examining its mediating role in associations with cannabis use and use-related outcomes might consider examining rumination as a multidimensional construct. It's been suggested that different kinds of rumination (e.g., angry rumination vs. depressed rumination) have a role in which of the aforementioned facets are most engaged with (Ciesla et al., 2011). Further research examining facets of rumination as mediators of associations between cannabis use motives and negative use consequences may further refine data informing the design of interventions aimed to reduce negative cannabis use consequences.

Limitations

A limitation of this study is the potential for recall bias in the self-report measures used, due to them being retrospective in nature. Further empirical work might benefit from using ecological momentary assessments in order to reduce this bias and provide more insight into any temporal ordering that might be present in the studied associations. Relatedly, the use of the cross-sectional survey design in our study means we're unable to demonstrate temporal precedence with regard to mediation of associations, and therefore we cannot make causal inferences. Lastly, the present study's use of convenience samples may also limit the generalizability of the present study's findings.

Conclusions

The rise in cannabis use and use-related problems are positively correlated, with the differentiated pathways between use motive variables and negative use consequences impacted by antecedent personality traits and temperament factors. Given that cognitive

processes (e.g., reappraisal, premeditation) interrupt associations between multiple trait factors and cannabis use-related outcomes, we sought to better understand the role of rumination, a perseverative cognitive coping process, in mediating these associations. Our multidimensional approach yielded results indicating that to no small effect, rumination plays a role in influencing an individual's use of cannabis to cope and subsequent experiences of negative use consequences, especially among those high in negative urgency and low in distress tolerance. We therefore conclude that rumination is a mechanism catalyzing some high-risk distal predictors of use towards negative use consequences, via higher use of cannabis to cope. Thus, interventions designed to decouple rumination from distal factors contributing to negative emotional states (i.e., distress tolerance and negative urgency) implicates reduction in negative use consequences via lower use of cannabis to cope.

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