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Cannabis Use Is Differentially Associated with Individual Facets of Impulsivity through Expectancy Effects: A Comprehensive Application of the Acquired Preparedness Model

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ABSTRACT

The acquired preparedness model (APM) posits that the relationship between impulsivity and substance use is mediated by drug effect expectancies. Though the APM has been utilized to explain college student cannabis use, a comprehensive model conceptualizing impulsivity as a multidimensional construct has not been examined. Guided by the APM, the current study examined facets of impulsivity as simultaneous predictors of cannabis use through positive and negative expectancies. College students ($N = 478$) completed an online survey assessing frequency of past-month cannabis use, facets of impulsivity, and cannabis expectancies. Using a bootstrapped path analysis, five facets of impulsivity were modeled as predictors of past-month cannabis use via positive and negative expectancies. A zero-inflated Poisson distribution was used, wherein dichotomous past-month cannabis use was examined independently of frequency. There was a significant indirect effect of sensation seeking on both increased likelihood and frequency of use through strong positive expectancies. Additionally, both negative and positive urgency were associated with a decreased likelihood of use through stronger negative expectancies, while lack of premeditation was associated with an increased likelihood of use through weaker negative expectancies. These results underscore the importance of examining impulsivity as a multi-dimensional construct in the understanding of college student cannabis use behavior.

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Introduction

Cannabis is the most commonly used illicit drug in the United States among individuals aged 12 and older, with 22.1% of 18- to 25-year-olds endorsing past-month use (Substance Abuse and Mental Health Services Administration 2017). Prevalence rates have increased over the past decade alongside a decline in perceived risk of regular cannabis use (Pacek, Mauro, and Martins 2015), despite evidence for an association between acute use and several negative consequences (e.g., memory and attention deficits, impaired psychomotor functioning; Broyd et al. 2016; Volkow et al. 2014). In fact, chronic, heavy use may result in serious outcomes including alterations in brain development and function, lower IQ, and increased risk of cannabis use disorder (Volkow et al. 2014). College students may be uniquely impacted, as past-year prevalence of cannabis use disorder is highest among those aged 18–25 years (Substance Abuse and Mental Health Services Administration 2019) and use recently reached a 30-year peak at 39% (Schulenberg et al. 2019). Importantly, universities are a high-risk setting for initiation of cannabis use. Among individuals entering college with no history of use, one quarter will initiate use, with higher rates for those who are offered cannabis (Pinchevsky et al. 2012). Cannabis use is perceived as an integral part of the college experience, which is directly associated with increased cannabis use frequency and negative consequences (Pearson, Bravo, and Sotelo 2019; Pearson, Kholodkov, and Gray 2017). Further, cannabis use is associated with decreased cognitive function and increased emotional problems, which may contribute to associations with poorer academic performance and delayed graduation among college students (Arria et al. 2015; Bruffaerts et al. 2018). Thus, identifying risk and etiological factors related to cannabis use specifically among this high-risk group is necessary.

Impulsivity (i.e., the tendency to engage in rapid, unplanned behavior with little thought to consequences;

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Potenza 2007) is an important predictor of the initiation and maintenance of substance use, including cannabis (De Wit 2009; VanderVeen, Hershberger, and Cyders 2016). An appreciation of impulsivity as a multifaceted construct has more recently emerged, comprised of: negative urgency (i.e., tendency to act rashly under conditions of negative affect), positive urgency (i.e., tendency to act rashly under conditions of positive affect), lack of premeditation (i.e., tendency to act in the spur of the moment without thinking), lack of perseverance (i.e., inability to remain focused when completing difficult or boring tasks), and sensation seeking (i.e., tendency to engage in thrill-seeking behavior; Cyders and Smith 2008; Whiteside and Lynam 2001). Support for distinguishing between facets of impulsivity comes from existing research illustrating that these facets are differentially related to certain aspects of risky behavior (Smith et al. 2007). Specifically, there are relations between negative and positive urgency and problems related to risky behavior, in which rash behavior in response to intense emotion is reinforced by immediate relief or pleasure. In contrast, sensation seeking appears more related to frequency of pursuing risky behavior, while lack of premeditation may result in risky behavior not because one actively pursues it, but because one fails to consider the potential consequences of engaging in it. Finally, lack of perseverance is associated with the inability to maintain motivation on a task, wherein opportunities to engage in other, perhaps more rewarding behaviors (e.g., substance use), may undermine one's attempts to maintain focus on not engaging in risky behavior (Smith et al. 2007).

Research examining differential associations between facets of impulsivity and substance use has primarily focused on alcohol. For example, lack of premeditation and sensation seeking are associated with frequency of alcohol use, whereas positive and negative urgency are associated with alcohol-related problems (Magid and Colder 2007; Shin, Hong, and Jeon 2012). While similar associations may hold for cannabis, limited research has examined facets outside of sensation seeking (VanderVeen, Hershberger, and Cyders 2016). Several studies find high sensation seeking is associated with greater likelihood of use, frequency, and negative consequences (Felton et al. 2015; Martin et al. 2002). Research examining relations with other impulsivity facets finds initial evidence that cannabis use and consequences are associated with both positive and negative urgency (Stautz and Cooper 2014), with mixed support for associations with premeditation (Castellanos-Ryan et al. 2013; Xiao 2008). Further examination of the relationship between cannabis use and facets of impulsivity is necessary, particularly examining unique relations with each facet, which has not been considered in most cannabis research.

Another influential determinant of substance use, including cannabis use, is expectancy theory, which posits that individuals engage in behaviors based on expectations for specific effects, which may or may not be accurate. Expectancies are the outcome of an individual's direct and vicarious learning history. Thus, substance use is motivated by the desire to achieve or avoid the effects individuals have come to believe are associated with use (Brown 1993). Positive expectancies (i.e., wanted outcomes, such as relaxation) tend to predict initiation and frequency of use, while negative expectancies (i.e., unwanted outcomes, such as cognitive impairment) are associated with reduced likelihood of use (Schafer and Brown 1991). Further, a notable aspect of expectancy theory is that positive and negative expectancies can be simultaneously held, and the extent to which these expectancies are held is malleable as a result of ongoing substance use experiences (Cameron, Stritzke, and Durkin 2003; Lee et al. 2015, 2018). While this work demonstrates the role of expectancies in cannabis use, expectancies alone do not fully account for the variance in use, as positive expectancies are not always associated with use (Kristjansson et al. 2012), and some individuals continue to use despite holding negative expectancies (Connor et al. 2011).

The acquired preparedness model (APM) integrates both impulsivity and expectancy theory to comprehensively explain substance use (Smith and Anderson 2001). The APM suggests that individuals high in inherited impulsivity may be predisposed to developing certain substance-related expectancies (e.g., "cannabis will make me feel good"), which subsequently influence their substance use behavior (McCarthy, Kroll, and Smith 2001; Smith and Anderson 2001). It is theorized that those high in impulsivity attend more readily to reward, and when faced with an aversive event, are likely to continue to seek reward or actively pursue relief from the aversive event. Resultantly, those high in impulsivity may be more likely to attend to reinforcing qualities of substance use, forming expectancies that influence future substance use (McCarthy, Kroll, and Smith 2001). More specifically, these individuals are likely to develop stronger positive and weaker negative expectancies. Thus, this framework proposes a mechanism by which learned expectancies mediate the relationship between impulsivity and substance use. Expectancies serve as the proximal factor through which impulsivity, a more distal predictor, is associated with substance use. To date, a few studies have examined the APM as an explanatory model for cannabis use, finding support for the model but via inconsistent mediational pathways.

For example, negative expectancies mediate the relation between impulsivity and cannabis use, though the direction of this relationship differs across samples. Vangsness, Bry, and LaBouvie (2005) found that impulsivity was positively associated with cannabis use through weaker negative expectancies among undergraduates, while Hayaki et al. (2011) found that impulsivity was negatively associated with cannabis use through stronger negative expectancies among community-recruited women. Other studies demonstrate a mediational pathway through positive expectancies, such that impulsivity is associated with stronger positive expectancies, which is associated with more frequent cannabis use (Bolles, Earleywine, and Gordis 2014; Hayaki et al. 2011; Luba et al. 2018). However, this research is limited in that several studies did not simultaneously examine pathways through both positive and negative expectancies. Further, only one study applying the APM to cannabis use has examined impulsivity via facets, finding that sensation seeking specifically predicted frequency of cannabis use and cannabis use disorder symptoms via positive expectancies in a sample of at-risk young adults (Curry et al. 2018). However, this study did not simultaneously include other facets of impulsivity as predictors into this model.

Altogether, prior investigations of the APM as a model to explain cannabis use have yielded discrepant findings. One source for these discrepancies may be the way in which impulsivity has been conceptualized. Given evidence supporting the multidimensionality of impulsivity, a comprehensive model including all facets of impulsivity as simultaneous predictors of cannabis use may clarify existing inconsistencies, while also providing a more refined understanding of how these facets differentially relate to use. As each facet of impulsivity captures a discriminant impulsivity-like trait and predicts different aspects of risky behavior (Smith et al. 2007), it is possible that the unique characteristics of each facet may modify the development and influence of expectancies. Therefore, a comprehensive model including all impulsivity facets as simultaneous predictors of cannabis use through both positive and negative expectancies is necessary to elucidate these relationships.

Thus, informed by the APM, the current study aimed to comprehensively examine the relationships between impulsivity, expectancy effects, and cannabis use to understand which facets of impulsivity are uniquely associated with cannabis use, and whether there are differential associations through positive and negative expectancy effects. We tested this explanatory model of cannabis use in college students to better conceptualize use and guide intervention efforts among a population at high-risk for cannabis use and consequences.

Methods

Participants and procedure

Undergraduate students (N = 478) between the ages of 18–25 (M = 19.42, SD = 1.61) years completed an online survey via a psychology department participant pool. Participants were predominantly female (63.2%) and freshmen (46.8%). Participants identified as White (84.6%), Hispanic (7.4%), mixed race (3.2%), Black (2.7%), Asian (1.9%), and American Indian (0.2%). After providing informed consent, participants completed measures of demographics, cannabis use and expectancies, and impulsivity via the Internet. This study was approved by the University of Wyoming Institutional Review Board and participants were compensated with course credit.

Measures

Participants reported if they had ever used cannabis, and if so, their frequency of past-month use (i.e., number of days). Cannabis expectancies were examined via the 48-item Marijuana Effect Expectancies Questionnaire (MEEQ; Schafer and Brown 1991) which assesses three positive expectancy (i.e., relaxation and tension reduction, social and sexual facilitation, perceptual and cognitive enhancement) and three negative expectancy (i.e., cognitive and behavioral impairment, global negative effects, craving and physical effects) factors. Each item is measured on a 5-point scale (1 = *strongly disagree*; 5 = *strongly agree*). Similar to prior research utilizing the MEEQ (e.g., Bolles, Earleywine, and Gordis 2014; Curry et al. 2018; Hayaki et al. 2011), this study collapsed the expectancy factors into higher-order positive (α = 0.89) and negative (α = 0.88) expectancy effects. Items were averaged across each higher-order scale such that higher scores indicate stronger expectancies.

Impulsivity was assessed via the 59-item UPPS-P Impulsive Behavior Scale (Lynam et al. 2006), which measures five facets of impulsivity: positive urgency (α = 0.94), negative urgency (α = 0.88), lack of premeditation (α = 0.85), lack of perseverance (α = 0.83), and sensation seeking (α = 0.85). Each item is measured on a 4-point scale (1 = *strongly agree* to 4 = *strongly disagree*), with higher scores indicating greater impulsive behavior.

Data analysis plan

A zero-inflated Poisson (ZIP) regression model was used in Mplus (Version 8.3; Muthén and Muthén 1998–2017) to test the relations between the five facets of impulsivity, positive and negative expectancies, and past-month

Table 1. Bivariate correlations and descriptive statistics among all study variables (N = 478).

	1	2	3	4	5	6	7	8	9	*M*	*SD*
1. Negative Urgency	–									2.11	0.54
2. Lack of Premeditation	**.31**	–								1.98	0.46
3. Lack of Perseverance	**.42**	**.55**	–							1.91	0.47
4. Sensation Seeking	.12	.02	**−.22**	–						2.80	0.56
5. Positive Urgency	**.75**	**.42**	**.44**	.13	–					1.81	0.57
6. Positive Expectancies	.15	−.03	−.01	.15	.12	–				3.14	0.55
7. Negative Expectancies	**.28**	−.08	.01	−.04	**.21**	**.26**	–			3.03	0.56
8. Past-Month Cannabis Use	−.03	.08	.24	.11	−.08	**.22**	**−.32**	–		2.63	6.73
9. Sex	−.001	−.04	.01	**−.31**	−.09	−.05	.15	**−.17**	–	0.63	0.48

Note. Sex was coded 0 = male, 1 = female. Significant correlations at p < .001 are in bold typeface for emphasis.

cannabis use. A ZIP model is ideally suited to test the hypothesized relations in this study, because the dependent variable is frequency of cannabis use, measured in a sample where the majority of individuals deny recent use (i.e., have a past-month frequency of zero). Among those who use, a Poisson distribution is appropriate (i.e., low frequency use is far more common than high frequency use), and the proportion of individuals not using at all is especially high. The ZIP model tests two questions: (1) a linear relation between predictor variables and frequency of cannabis use; and (2) a logistic relation for engaging in cannabis use or not. In other words, the ZIP model allows for predicting presence of use and frequency of use separately. Individuals indicating they had never used cannabis were coded with a zero for past-month frequency. We included the five facets of impulsivity as independent variables that had direct paths to past-month cannabis use. We also included the indirect paths of these five facets through negative and positive expectancies, in addition to the direct paths from expectancies to use. The indirect paths test for mediation effects. Finally, due to sex differences in frequency of use, we included sex as a covariate. We used maximum likelihood estimation and obtained 1000 bootstrapped samples to derive standard errors and asymmetric confidence intervals, which is appropriate when testing indirect effects. Fit of models was examined using Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and sample-size adjusted BIC, all of which are interpreted as smaller being better. We interpreted paths with 95% confidence intervals that did not include zero as statistically significant.

Results

Twenty-nine percent of the sample reported past-month cannabis use. Among users, frequency of use ranged from 1 to 30 days in the last month (M = 9.06, SD = 9.90). Descriptive statistics and bivariate correlations among study variables are presented in Table 1.

Sex demonstrated significant relations with negative expectancies (B = 0.15, SE = 0.05, p = .002) and frequency of past-month cannabis use (B = −0.49, SE = 0.18, p = .007) but not positive expectancies (B = −0.002, SE = 0.05, p = .964) or presence of past-month cannabis use (B = 0.03, SE = 0.30, p = .915), so only the significant paths were retained. The modified model demonstrated a better fit, with the AIC (3455.69 vs. 3451.70), BIC (3597.46 vs. 3585.13), and sample-size adjusted BIC (3489.54 vs. 3483.57) all decreasing in the model that dropped the non-significant paths. Direct effects from facets of impulsivity to past-month cannabis use and their indirect effects through expectancies in the modified model appear in Table 2. The full model, including all direct effects, is depicted in Figure 1.

There were significant direct effects of sensation seeking on positive expectancies and significant direct effects of negative urgency, lack of premeditation, and positive urgency on negative expectancies. These effects were such that higher sensation seeking was associated with stronger positive expectancies, higher negative urgency, and higher positive urgency were each associated with stronger negative expectancies, and higher lack of premeditation was associated with weaker negative expectancies.

Past-month cannabis use (present/absent)

Negative urgency, lack of premeditation, and sensation seeking were positively associated with increased likelihood of past-month cannabis use, while positive urgency was negatively associated with past-month cannabis use. Lack of perseverance was not associated with past-month use. Positive expectancies demonstrated a direct effect on presence of past-month cannabis use (B = 1.60, SE = 0.44, p < .001), with stronger positive expectancies being associated with higher likelihood of use. Negative expectancies also demonstrated a significant direct effect with likelihood of past-month cannabis use (B = −3.14, SE = 0.40, p < .001), with

Table 2. Summary of direct and indirect effects of impulsivity facets on past-month cannabis use via positive and negative expectancy effects.

Predictor: *Negative Urgency*	*β*	95% CI
Outcome: Any Past-Month Use		
Direct	**0.85**	**0.04, 1.74**
Total Indirect	**-0.70**	**-1.19, -0.18**
Positive Expectancies	0.20	-0.04, 0.59
Negative Expectancies	**-0.90**	**-1.44, -0.49**
Outcome: Frequency of Use		
Direct	0.18	-0.24, 0.66
Total Indirect	-0.001	-0.18, 0.20
Positive Expectancies	0.11	-0.03, 0.27
Negative Expectancies	-0.11	-0.24, 0.01
Predictor: *Lack of Premeditation*	*β*	95% CI
Outcome: Any Past-Month Use		
Direct	**0.74**	**0.03, 1.61**
Total Indirect	**0.42**	**0.07, 0.85**
Positive Expectancies	-0.19	-0.46, 0.01
Negative Expectancies	**0.61**	**0.27, 1.06**
Outcome: Frequency of Use		
Direct	0.11	-0.31, 0.53
Total Indirect	-0.03	-0.18, 0.11
Positive Expectancies	-0.10	-0.22, 0.004
Negative Expectancies	0.08	-0.01, 0.20
Predictor: *Lack of Perseverance*	*β*	95% CI
Outcome: Any Past-Month Use		
Direct	0.71	-0.01, 1.43
Total Indirect	0.33	-0.03, 0.78
Positive Expectancies	-0.01	-0.22, 0.20
Negative Expectancies	0.34	-0.04, 0.78
Outcome: Frequency of Use		
Direct	0.30	-0.19, 0.78
Total Indirect	0.04	-0.08, 0.17
Positive Expectancies	-0.01	-0.12, 0.12
Negative Expectancies	0.04	-0.01, 0.12
Predictor: *Sensation Seeking*	*β*	95% CI
Outcome: Any Past-Month Use		
Direct	**0.57**	**0.02, 1.19**
Total Indirect	**0.39**	**0.05, 0.80**
Positive Expectancies	**0.18**	**0.01, 0.40**
Negative Expectancies	0.21	-0.10, 0.55
Outcome: Frequency of Use		
Direct	-0.12	-0.50, 0.29
Total Indirect	**0.12**	**0.03, 0.24**
Positive Expectancies	**0.10**	**0.01, 0.20**
Negative Expectancies	0.03	-0.02, 0.09
Predictor: *Positive Urgency*	*β*	95% CI
Outcome: Any Past-Month Use		
Direct	**-1.25**	**-2.11, -0.52**
Total Indirect	-0.30	-0.80, 0.06
Positive Expectancies	0.09	-0.21, 0.33
Negative Expectancies	**-0.39**	**-0.83, -0.03**
Outcome: Frequency of Use		
Direct	-0.27	-0.80, 0.18
Total Indirect	-0.002	-0.16, 0.14
Positive Expectancies	0.05	-0.10, 0.19
Negative Expectancies	-0.05	-0.15, 0.004

Note. Significant associations are in bold typeface for emphasis and were determined by a 95% bootstrapped confidence interval (based on 1,000 bootstrapped samples) that does not contain zero. Total Indirect reflects the combined indirect associations within the model. Sex was included in the model as a covariate; its effects are not shown in the table for parsimony but are available upon request from the authors.

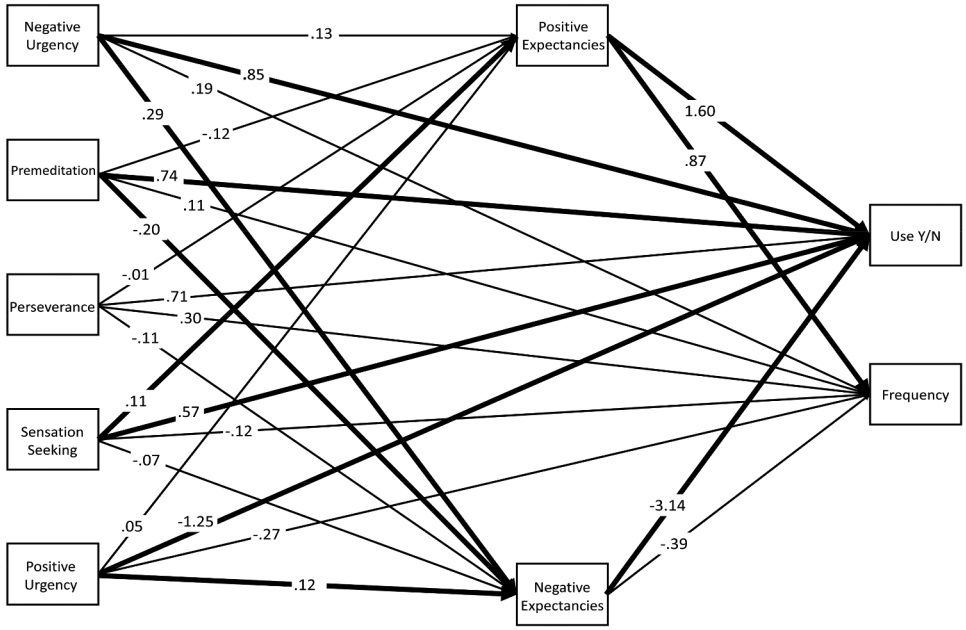

Figure 1. Path model depicting effects of impulsivity on past-month cannabis use via positive and negative expectancy effects. *Note*. Depicts the standardized effects of the path model predicting cannabis use. Significant paths at $p < .05$ are bolded and were determined by a 95% bootstrapped confidence interval (based on 1,000 bootstrapped samples) that does not contain zero.

stronger negative expectancies being associated with a lower likelihood of past-month use.

With regard to tests of indirect effects, we found significant mediation of the effect from negative urgency, lack of premeditation, sensation seeking, and positive urgency to past-month cannabis use. There was no indirect effect involving lack of perseverance. The indirect effect from negative urgency, lack of premeditation, and positive urgency went through negative expectancies, whereas the effect for sensation seeking went through positive expectancies. For both negative urgency and positive urgency, higher standing was associated with lower likelihood of past-month cannabis use through stronger negative expectancies. Higher standing on lack of premeditation was associated with higher likelihood of use through weaker negative expectancies. Finally, higher standing on sensation seeking was associated with higher likelihood of past month use through stronger positive expectancies.

Past-month frequency of cannabis use

No facets of impulsivity demonstrated direct effects on frequency of past-month cannabis use. Positive expectancies demonstrated a direct effect on frequency of past-month cannabis use ($B = 0.87$, $SE = 0.16$, $p < .001$), with stronger positive expectancies being associated with more frequent use. Negative expectancies were not associated with past-month frequency of use ($B = -0.39$, $SE = 0.22$, $p = .070$).

With respect to indirect effects on frequency of past-month cannabis use, only sensation seeking demonstrated an effect and it went through positive expectancies. The nature of this effect suggests that higher sensation seeking is associated with higher frequency of past-month cannabis use though higher positive expectancies.

Discussion

The current study utilized the APM framework to examine relationships between impulsivity, expectancy effects, and cannabis use. Five distinct facets of impulsivity were simultaneously examined to determine the presence of differential associations with cannabis use through positive and negative expectancy effects. This study expands upon previous work by examining specific impulsivity facets and their relation to two cannabis outcomes – past-month use and past-month frequency of use – through both positive and negative expectancies. All facets, apart from lack of perseverance, demonstrated differential associations with cannabis use through expectancies. Results from this study elucidate complex relationships underlying the APM, such that cannabis use outcomes are contingent upon distinct facets of impulsivity and expectancy type.

Consistent with previous research (Curry et al. 2018), positive cannabis expectancies mediated the relationship between sensation seeking and both past-month cannabis use and frequency of use. Importantly, sensation seeking was the only impulsivity facet to indirectly relate

to frequency of use. Sensation seeking may uniquely lead individuals to acquire beliefs about the positive effects of cannabis, which in turn, leads to a higher likelihood of engaging in cannabis use and use that is more frequent. The unique relation between sensation seeking and frequency of use through positive expectancies may be indicative of other factors that those high in this facet may be particularly sensitive to, such as strong enhancement motives for use (Magid, MacLean, and Colder 2007), leading to increased frequency of use. Perhaps high sensation seeking leads individuals to be principally motivated to use cannabis to enhance positive mood, during which they subjectively experience elevated mood or arousal, serving to enhance their positive beliefs about cannabis and increase frequency of use. This link may be particularly salient for college students, as some research demonstrates that the most strongly held motives across cannabis use episodes among college students are enhancement motives (Pearson, Bravo, and Sotelo 2019).

Lack of premeditation was also associated with an increased likelihood of past-month cannabis use, though this relation was mediated by weaker negative expectancies. College students high in lack of premeditation may have difficulties reflecting on the negative consequences associated with cannabis use and fail to develop strong negative expectancies. There is evidence that impulsivity is associated with deficits in executive function and that this may be particularly relevant for those with the propensity to act without thinking (Romer et al. 2011). Specifically, research has demonstrated an association between lack of premeditation and deficits in updating (Nordvall, Neely, and Jonsson 2017), an executive function that involves the monitoring of incoming information for relevance and replacing old, no longer relevant information with newer, more salient information (Miyake et al. 2000). Perhaps, when confronted with negative cannabis-related information, individuals high in lack of premeditation are unable to efficiently process and replace existing cannabis-related beliefs with new, negative cannabis-related information due to this specific executive functioning deficit, preventing the development of stronger negative expectancies and consequently maintaining cannabis use.

In contrast, both negative and positive urgency were associated with a decreased likelihood of past-month cannabis use, mediated by strong negative expectancies for both facets. Specifically, the tendency to engage in rash behavior under conditions of either negative or positive effect was associated with holding stronger negative beliefs about the effects of cannabis and subsequently being less likely to engage in cannabis use. College students who engage in cannabis use under intense emotion may experience more negative cannabis-related outcomes, leading to stronger negative expectancies and decreased likelihood of use. This aligns with previous findings that negative expectancies predict decreased substance use (Schafer and Brown 1991). It is important to note that the direct effect of negative urgency on use was positive, aligning with recent research demonstrating a positive association between negative urgency and increased cannabis use (Um, Hershberger, and Cyders 2019; VanderVeen, Hershberger, and Cyders 2016), Notably, it appears that negative urgency is associated with a decreased likelihood of past-month cannabis use through expectancies, suggesting that expectancies play an important role in determining future use. Perhaps college students high in negative urgency, particularly those with no prior history of use, and thus weak existing expectancies, initially use cannabis in an attempt to mitigate negative emotions, but ultimately develop negative cannabis-related expectancies after experiencing negative consequences while using. In fact, research supports a direct positive association between negative urgency and cannabis-related consequences (Bravo, Prince, and Pearson 2017). Interestingly, in contrast with negative urgency, the direct association between positive urgency and cannabis use was negative, indicating that expectancies may not play as crucial a differentiating role for this facet. It could be that students high in positive urgency may be apt to use substances with stimulatory effects in times of positive mood, and not drugs with the potential for relaxant effects, such as cannabis.

Lack of perseverance was the only impulsivity facet that did not demonstrate a significant direct or indirect relation with cannabis use. This finding aligns with previous work demonstrating that lack of perseverance was the only impulsivity trait unrelated to cannabis use or cannabis-related consequences (VanderVeen, Hershberger, and Cyders 2016). Inability to remain focused when completing difficult or boring tasks may not uniquely relate to cannabis use in the same way as other impulsivity facets, particularly those that are affect-related (e.g., urgency, sensation seeking) and known to relate to substance use more generally through enhancement or coping motives (Cooper et al. 2016). Though additional research on lack of perseverance is needed, this facet may not serve as a unique indicator of cannabis use for college students.

Taken together, results from the current study suggest that cannabis-related expectancies may explain the relationship between impulsivity and cannabis use. However, this depends on several factors, including the facet of impulsivity being assessed, the type of expectancy, and the way in which cannabis use is quantified (e.g., past-month use vs. past-month frequency of use).

One study limitation includes a homogenous sample largely comprised of White, female undergraduate students from a single university. These results may not generalize to non-college students or racially diverse samples. However, the prevalence of cannabis use in our sample is consistent with that of 18- to 25-year-olds in a recent epidemiological survey (SAMSHA 2019), indicating the appropriateness of this sample for examining cannabis use. Next, the cross-sectional nature of this research limits the ability to make conclusions about the temporal ordering of effects. The gathering of temporal, longitudinal data will provide better insight into how cannabis expectancies develop and shift over time and influence future use. Additionally, cannabis use was measured via self-reported days of use over the past month, and future research would benefit from using methods that provide a more comprehensive history of past-month cannabis use and are less subject to self-report biases (e.g., ecological momentary assessment; biological assessments of use). Further, the group of individuals denying past-month cannabis use contained individuals both with and without a lifetime history of use, making a heterogeneous group of current non-users. Finally, the inclusion and examination of additional potentially influential variables (e.g., negative affect) in future models is necessary as the current study did not collect this data.

This study further clarifies the role of both expectancies and impulsivity facets in cannabis use among college students and suggests important clinical implications for cannabis use prevention and intervention efforts. As personality-targeted interventions are supported in reducing alcohol and other drug use (Conrod, Castellanos-Ryan, and Mackie 2011), future research should examine the efficacy of implementing similar impulsivity-targeted interventions for reducing cannabis use. For example, promoting or training cannabis protective behavioral strategies may serve to reduce risk of problematic use and/or the development of a cannabis use disorder among those who report high levels of sensation seeking and/or urgency (Bravo, Prince, and Pearson 2017). In addition, there is promising evidence for using mindfulness-based strategies to target impulsivity at the trait level among college students who use alcohol (Vinci et al. 2016). While yet to be studied, mindfulness interventions may similarly prove effective among college students who use cannabis. Further, given that negative expectancies were found to be protective against the maintenance and continuance of cannabis use, interventions aimed at strengthening negative expectancies may serve as a means for early intervention. Finally, existing alcohol research indicates support for expectancy challenge interventions, which act to weaken an individual's positive expectancies surrounding alcohol (Scott-Sheldon et al. 2012). However, limited research has examined their efficacy for cannabis use (Skenderian et al. 2008). Future research examining the viability of expectancy challenge interventions for cannabis use is warranted, particularly if they aim to modify negative, as well as positive, expectancies.

Overall, the current study helps clarify prior discrepant results by including each facet of impulsivity as simultaneous predictors of cannabis use through both positive and negative expectancies. Crucially, these results illustrate the importance of investigating impulsivity as a multidimensional construct when examining cannabis use behaviors in college students. A comprehensive approach to understanding the confluence of multiple factors associated with cannabis use can aid in the development of effective intervention efforts for this at-risk population.

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