Journal of Psychoactive Drugs

ISSN: 0279-1072 (Print) 2159-9777 (Online) Journal homepage: https://www.tandfonline.com/loi/ujpd20

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To cite this article: Rachel Luba, Mitch Earleywine, Stacey Farmer, Melissa Slavin, Maha Mian & Brianna Altman (2018) The Role of Impulsivity and Expectancies in Predicting Marijuana Use: An Application of the Acquired Preparedness Model, Journal of Psychoactive Drugs, 50:5, 411-419, DOI: 10.1080/02791072.2018.1511877

To link to this article: https://doi.org/10.1080/02791072.2018.1511877

Published online: 05 Sep 2018.

JOURNAL OF PSYCHOACTIVE DRUGS
2018, VOL. 50, NO. 5, 411–419
https://doi.org/10.1080/02791072.2018.1511877

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The Role of Impulsivity and Expectancies in Predicting Marijuana Use: An Application of the Acquired Preparedness Model

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ABSTRACT

Impulsivity and substance use covary. Smith and Anderson's acquired preparedness model proposes that impulsivity predicts substance use through a mediational model such that substance use expectancies mediate the relation between impulsivity and drug use. The present study seeks to examine the relation between positive urgency, an important component of impulsivity with specific relations to substance use behavior, marijuana expectancies, and marijuana use patterns. The study focused on a sample of frequent marijuana users (n = 3,616) and assessed positive urgency using the UPPS-P, expectancies using the Biphasic Marijuana Effects Scale, an adapted form of the Biphasic Alcohol Effects Scale to measure the sedative and stimulant properties of marijuana, and also assessed use patterns. Findings suggest that stimulant expectancies predict heavier, more frequent marijuana use than sedative expectancies and that marijuana expectancies vary based on the limb of marijuana intoxication. Examination of the acquired preparedness model revealed that positive urgency's link to marijuana use was fully mediated by expectancies.

ARTICLE HISTORY
Received 6 November 2017
Accepted 11 June 2018

KEYWORDS
Expectancies; impulsivity; marijuana use

Introduction

Marijuana is the most commonly used psychoactive substance in the United States (NIDA 2017). Frequent, heavy marijuana use predicts marijuana-associated problems, with heavy users more likely to report respiratory problems and difficulty fulfilling role obligations (Fergusson and Boden 2008; Hall and Degenhardt 2009; Loflin and Earleywine 2015). As legislation and attitudes toward marijuana change, it is important to identify factors that predict the most problematic use in aiding harm reduction.

Two predominant theories of the etiology of substance use focus on specific personality traits and on psychosocial learning (Smith and Cyders 2016). In examining personality traits, impulsivity consistently predicts substance use initiation and maintenance (Moeller et al. 2002). Psychosocial learning histories also appear to predict substance use, with research focusing on individuals' expectancies for a substance as a reliable predictor of use (Goldman, Brown, and Christiansen 1987). Historically, research has been divided, attributing variance in substance use to specific personality traits or to individual learning histories. Nevertheless, neither focus fully explains variance in drug use.

Impulsivity and substance use

Impulsivity is an individual's tendency to engage in erratic or unplanned behavior with little consideration of the consequences (de Wit 2009). Several measures of impulsivity further refine the construct into distinct patterns of behavior. The Urgency, Premeditation, Perseverance, Sensation Seeking, Positive Urgency Impulsive Behavior Scale (UPPS-P) divides impulsivity into five subscales (Whiteside and Lynam 2001). Urgency, broken down into positive and negative urgency, is characterized by a tendency to act impulsively when experiencing marked positive or negative affect, respectively. Premeditation is an individual's tendency to reflect on the consequences of a behavior before acting. Perseverance is the capacity for attention or focus during tedious tasks. Finally, sensation seeking is the tendency to engage in exciting or thrill-seeking behavior.

While impulsivity broadly predicts substance use, different facets of impulsivity predict use patterns in distinct ways. Existing research has focused on sensa-

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tion seeking and positive urgency as predictors of substance use. Specifically, individual differences in sensation seeking and positive urgency are associated with increased use and abuse of alcohol, tobacco, opiates, and cocaine (Mitchell and Potenza 2014). One explanation of this association, the Mechanism of Disinhibition, proposes that impulsive individuals are more likely to attend to the positive, immediate rewards associated with a substance, rather than its consequences or long-term effects (Patterson and Newman 1993).

Research suggests that impulsivity contributes to variance in marijuana use. In a meta-analysis of studies on impulsivity traits and marijuana use among adolescents, sensation seeking, lack of planning, and positive urgency predicted negative marijuana consequences, with moderate effect sizes (VanderVeen, Hershberger, and Cyders 2016). A significant, positive relation between impulsivity, as measured by the Impulsiveness Subscale of the Eysenck I_7, and marijuana use frequency has also been observed (Vangsness, Bry, and LaBouvie 2005). Robinson, Ladd, and Anderson (2014) also demonstrated an association between positive urgency and lifetime marijuana use among adolescent students. Thus, while impulsivity broadly predicts substance use, these data suggest that positive urgency and sensation seeking may be particularly salient predictors of marijuana use outcomes.

While research supports the role of impulsivity in predicting substance use initiation and maintenance, personality factors do not entirely explain variance in substance use. For example, even in studies showing strong associations between impulsivity and drug use, effect sizes are small to moderate, implicating the role of other factors in the etiology of substance use (VanderVeen, Hershberger, and Cyders 2016). Similarly, research demonstrates individual differences in developing problematic substance use patterns, suggesting that additional factors likely account for variance in drug use (Kotov et al. 2010; Sloboda, Glantz, and Tarter 2012).

Expectancies

Outcome expectancy theory posits that individuals engage in behaviors based on beliefs about the outcome of such behavior. With substance use, drug-taking behavior is motivated by a desire to attain reinforcing effects perceived to be associated with a drug (Jones, Corbin, and Fromme 2001). A drug's expected effects predict patterns of use and abuse (Goldman, Brown, and Christiansen 1987). Drug use expectancies develop and change as individuals mature. Exposure to substance use through peers, family members, and the media contribute to the development of expectancies even prior to substance use initiation (Brown, Creamer, and Stetson 1987). Through direct experience with a substance, expectancies are either confirmed or challenged, with confirmed positive expectancies likely to maintain use (Dunn and Goldman 1998).

Though the relation between marijuana expectancies and marijuana use patterns is less researched, expectancies appear to covary with frequency and quantity of use, as well as associated problems. A study of adolescent marijuana expectancies over three years demonstrated that positive ratings of expected effects significantly predicted earlier marijuana use initiation and greater rates of use over time (Fulton, Krank, and Stewart 2012). In another study, global positive expectancies were associated with adolescent marijuana use, but not significantly associated with adult marijuana use. Interestingly, expectancies of cognitive-behavioral impairment were negatively associated with adolescent and adult marijuana use, suggesting a protective role of negative expectancies (Kristjansson et al. 2012).

Positive expectancies include desirable mood states or subjective effects resulting from drug use (e.g., "I expect to feel excitement and pleasure if I use cocaine"). Positive expectancies increase the likelihood of drug use initiation and maintenance (Leventhal and Schmitz 2006). Negative expectancies tend to reduce the likelihood of drug use (e.g., "I expect to feel lousy the day after drinking"). The direction and strength of expectancies explains variance in drug use (Leventhal and Schmitz 2006). Strong positive expectancies tend to predict increased frequency of use, while negative expectancies are higher among individuals who never initiate use (Gaher and Simons 2007; Schafer and Brown 1991). While research support for the link between positive expectancies and drug use is robust, the relation between negative expectancies and drug use is somewhat less clear. Research demonstrates that negative expectancies may be protective with regard to alcohol (Leigh and Stacy 2004), nicotine (Gilbert and Warburton 2003), and marijuana use (Aarons et al. 2001). Overall, many studies suggest that strong negative expectancies are associated with reduced substance use or increased rates of abstinence. Still, some research finds no effect between negative expectancies and substance use, suggesting a need for further work (Buckner and Schmidt 2008; Neighbors, Geisner, and Lee 2008).

In addition to characterizations of expectancies as positive or negative, research suggests that the stimulant and/or sedative properties of a substance influence the development of expectancies (Morean, Corbin, and Treat 2015). Some substances have both stimulant and

sedative properties that vary with dosage and time. Research suggests a biphasic response to alcohol such that stimulant effects occur on the ascending limb of the blood alcohol curve, while sedative effects occur on the descending limb (Holdstock and de Wit 1998). Further, characterizing drug expectancies as stimulant or sedative provides a more nuanced understanding of expectancies. While typically considered a depressant, marijuana also has both stimulant and sedative properties (Block et al. 1998). Thus, examinations of the role of marijuana expectancies on use can benefit from studying both stimulant and sedative effects.

While expectancies are considered a strong predictor of substance use and abuse patterns, expectancies alone do not fully account for variance in substance use. In their review, Leventhal and Schmitz (2006) discuss 21 studies that provide evidence for the role of expectancies in predicting alcohol, cocaine, tobacco, and marijuana use. Several of these studies examined expectancies as a mediator in the relation between identified risk factors and substance use outcomes, with sensation seeking, impulsivity, and disinhibition as salient risk factors. Further research is needed to understand the nature of expectancies as a mediator in the link between psychosocial risk factors and substance use.

The Acquired Preparedness Model

The Acquired Preparedness Model (APM) combines a focus on drug expectancies and impulsivity in a mediational model of drug use. This model suggests that more impulsive individuals are more likely to develop expectancies about a substance that sustain chronic use. Impulsivity is associated with more positive pre-initiation expectancies, likely contributing to future drug use initiation (Smith and Anderson 2001). Such positive expectancies may develop as a result of impulsive individuals' tendency to attend to the positive, immediately rewarding aspects of a stimulus.

Researchers have applied the APM to alcohol use (Scott and Corbin 2014; Settles, Cyders, and Smith 2010), tobacco use (Doran et al. 2013; Combs et al. 2012), gambling (Ginley et al. 2015), and binge eating disorder (Pearson, Zapolski, and Smith 2015). Three studies have examined the APM in marijuana users, with findings demonstrating partial (Bolles, Earleywine, and Gordis 2014; Vangsness, Bry, and LaBouvie 2005) and full (Hayaki et al. 2010) mediation. Generally, impulsive individuals endorse fewer negative expectancies and use marijuana more frequently (Vangsness, Bry, and LaBouvie 2005), or endorse more positive marijuana expectancies and use marijuana more often (Bolles, Earleywine, and Gordis 2014; Hayaki et al. 2010). Given the prevalence of marijuana use, and the evidence for the APM with other substances, further research may articulate the combined role of impulsivity and expectancies in predicting problematic marijuana use. While three studies have applied the APM to marijuana use, findings are mixed with regard to the role of positive and negative expectancies as well as specific facets of impulsivity. A clearer understanding of the manner in which specific expectancies partially or fully mediate the relation between facets of impulsivity and marijuana use can provide insights into prevention and intervention strategies, as well as identifying users most at risk for problematic marijuana use.

The present study

The present study examines marijuana expectancies in predicting use patterns, and categorizes the effects of marijuana as stimulant or sedative to examine whether marijuana users expect a biphasic response to the substance. We applied the APM to a sample of frequent marijuana users. We examined the role of positive urgency as a predictor of marijuana use and evaluated whether individuals with elevated scores on positive urgency were more likely to develop heavy marijuana use, and in what way expectancies mediate this relation. We hypothesized that individuals with greater scores on positive urgency would endorse more stimulant expectancies and thus engage in more frequent, heavy marijuana use. Positive urgency was selected as the primary facet of impulsivity, given research suggesting its unique link to problematic marijuana use (Mitchell and Potenza 2014; Robinson, Ladd, and Anderson 2014; VanderVeen, Hershberger, and Cyders 2016).

Method

Participants were recruited via the email listserv of the National Organization for the Reform of Marijuana Laws (NORML). Prior to survey initiation, participants completed informed consent procedures. The University at Albany, State University of New York, Institutional Review Board approved all survey materials and procedures. Participants (N = 3,616) completed an online survey. The sample was 31% female, and the mean age was 46.93 (SD = 14.6). Eighty-six percent reported that they were Caucasian, followed by mixed race (5%), Hispanic (4%), African American or Caribbean (2%), Native American (1%), and Asian or Pacific Islander (.4%). Sample characteristics can be found in Table 1.

Table 1. Characteristics of study sample.

Characteristic	*n*	%
Gender		
Male	2,452	68.1
Female	1,104	30.5
Race/Ethnicity		
Caucasian	3,119	86.3
More than one race	190	5.3
Hispanic/Latino	130	3.6
African American	71	2
Native American	40	1.1
Asian	16	.4
Other	6	.2
Education		
Some high school	79	2.2
Finished high school/GED	494	13.7
Some college	1,204	33.3
Associates degree	471	13.0
Bachelors degree	783	21.7
Current student	162	4.5
Advanced degree	409	11.3
Cannabis Use		
Past month	3,616	100
	Mean	SD
Age	46.9	14.6
Cannabis use per month (days/month)	25.1	8.8
Cannabis use per month (ounces/month)	3.2	1.7
Cannabis use per week (days/week)	5.9	1.9
Joints per week	7.8	12.4
Intoxication	4.5	1.1

Measures

Following demographic questions, the measures were presented as follows.

Quantity/frequency of marijuana use

Participants were asked to report if they used marijuana in the past month, number of days per month and per week of marijuana use, number of joints smoked each week, and number of ounces of marijuana used each month.

Positive urgency

The UPPS-P was used to measure impulsive behavior, with emphasis on five pathways of impulsivity (Lynam et al. 2006). The present study focused on positive urgency, the tendency to engage in risky or impulsive behaviors with positive affect. The positive urgency subscale of the UPPS-P consists of 14 items, each rated on a 4-point scale from 1 (agree strongly) to 4 (disagree strongly). The 14 items were reverse coded prior to scoring and were summed to generate individual positive urgency ratings. The UPPS-P has demonstrated high internal consistency and high test-retest reliability across all five pathways (Baggott, de Wit, and Weafer 2013; Lynam et al. 2006).

Biphasic Marijuana Effects Scale (ascending and descending limbs)

The Biphasic Alcohol Effects Scale was adapted for marijuana users (Martin et al. 1993). This 14-item scale measures stimulant and sedative effects of marijuana and asks participants to choose between 0 (not at all) and 10 (extremely) to rate the anticipated effects of marijuana. Stimulant items include: elated, energized, excited, stimulated, up, talkative, and vigorous. Sedative items include: difficulty concentrating, down, heavy head, inactive, sedated, slow thoughts, and sluggish. Participants completed the Biphasic Marijuana Effects Scale (BMES) for two situations: (1) immediately after using marijuana (ascending limb); and (2) two hours after using marijuana (descending limb). Stimulant items were reverse coded with higher overall scores on the BMES suggesting more sedative expectancies and lower scores suggesting more stimulant expectancies. Cronbach's alpha estimate for the BMES was .82 in this study sample, suggesting moderate internal consistency.

Results

Marijuana use

Subjects reported using marijuana an average of 25.1 (SD = 8.797) days per month, 5.86 (SD = 1.92) days per week, and reported using an average of 7.84 (SD = 12.36) joints per week. Participants reported an average of 3.2 (SD = 1.68) ounces of marijuana used per month.

Positive urgency

Participants had a mean score of 1.27 (SD = .37) on the UPPS-P positive urgency subscale. Significant skew appeared for this variable, necessitating transformations to satisfy the assumptions of parametric statistics (initial skew = 2.30; Box-Cox Transformed skew = 0.60) (Osborne 2010). Parametric tests were performed using this transformed variable; however, means and SDs of the untransformed variable are reported to facilitate easier interpretation.

Biphasic Marijuana Effects Scale

Mean scores on the BMES varied based on limb, with participants reporting significantly higher scores two hours following use of marijuana compared to immediately following use ($t = -29.13$, $p < .001$). Higher scores on the descending limb of intoxication suggest increasing sedation over time, and decreasing stimulation from

Table 2. Table of correlations.

	Mean (SD)	1.	2.	3.	4.
1. Ascending	4.56 (1.19)	1			
2. Descending	5.05 (1.26)	0.69	1		
3. Positive Urgency	1.27 (0.37)	−0.10	−0.11	1	
4. Marijuana Use	3.20 (1.68)	−0.12	−0.11	−0.04	1

Note. All correlations significant at the 0.01 level; marijuana use: ounces of marijuana used per month.

ascending to descending limb. Means and standard deviations for each limb can be found in Table 2.

Relation to marijuana consumption

BMES scores correlated significantly with the amount of marijuana used per month. For both limbs of intoxication, scores inversely related to marijuana use (ascending: r = −.12, $p < .001$; descending: r = −.22, $p < .001$). Since higher scores on the BMES suggest more sedative expectancies, these findings suggest that sedative expectancies are associated with decreased marijuana use.

Expectancies and positive urgency

Bivariate correlations also examined the relation between positive urgency and expectancies. Scores on the UPPS-P were negatively correlated with BMES scores (ascending: r = −.10, $p < .001$; descending: r = −.11, $p < .001$). Again, higher BMES scores suggest more sedative marijuana expectancies. This finding suggests that higher scores on positive urgency are associated with less sedative expectancies.

Acquired Preparedness Model

Hayes' PROCESS macro was used to perform a mediation analysis. In step 1 of the model, the regression of positive urgency on quantity of marijuana use per month (in ounces), ignoring the mediator, was significant (b = .62, $p < .05$). Step 2 showed that the regression of positive urgency on the mediator expectancies was also significant for both the ascending and descending limbs of intoxication (ascending: b = −.64, $p < .001$; descending: b = −.96, $p < .001$). Step 3 of the model showed that the mediator (expectancies), controlling for positive urgency, was significant for both limbs of intoxication (ascending: b = −.10, $p < .05$; descending: b = −.10, $p < .05$). Step 4 showed that, controlling for the mediator (expectancies), positive urgency was not a significant predictor of marijuana use (b = −.50, $p = .50$). A Sobel test found full mediation in the model (ascending: z = −.10, $p < .05$; descending: z = −.10, $p < .05$). Expectancies fully mediated the relation between positive urgency and marijuana use. Table 3 illustrates these findings.

Table 3. Normal theory test.

	Coefficient	SE	t	*p*
Effect of positive urgency on expectancies (a path)				
Ascending	−.64	.17	3.75	.0002
Descending	−.96	.18	5.30	.0000
Effect of expectancies on marijuana use (b path)				
Ascending	−.10	.04	−2.90	.004
Descending	−.10	.03	−2.42	.02
Direct effect of positive urgency on marijuana use (c path)	.62	.24	−2.57	.01

Discussion

The present study examined the association between positive urgency, expectancies, and marijuana use patterns among frequent marijuana users. We assessed the stimulant and sedative properties of marijuana and examined their role in predicting expectancies and use patterns. Our findings confirmed our hypotheses that marijuana expectancies predict patterns of use and that positive urgency contributes to marijuana expectancies. As expectations of sedation increase, the frequency of marijuana consumption decreases. Individuals with greater positive urgency were significantly less likely to endorse sedative marijuana expectancies for both limbs of intoxication, resulting in greater marijuana use. A mediation model examined the role of acquired preparedness in predicting marijuana use. The APM proposes that expectancies mediate the relation between impulsivity and substance use. This model, applied to the current data, revealed full mediation, with expectancies on the ascending and descending limbs of intoxication mediating the relation between impulsivity and quantity of marijuana used per month. More impulsive individuals reported less sedative expectancies and, in turn, used marijuana more often. This finding held true for both the ascending and descending limbs of marijuana intoxication. These results provide insight into the etiology of marijuana use, and offer support consistent with the application of the APM among marijuana users (Bolles, Earleywine, and Gordis 2014; Vangsness, Bry, and LaBouvie 2005).

Study findings have implications for treatment of marijuana use disorder and prevention of problematic use. With growing evidence that impulsivity contributes to the development of expectancies that maintain use, targeting impulsivity is a clear point of intervention (Conrod, Castellanos-Ryan, and Mackie 2011; Dougherty et al. 2013). Interventions highlighting impulsivity show utility for alcohol use (Blonigen, Timko, and Moos 2013), binge eating

(Combs et al. 2010), and adolescent marijuana use (Crews and Boettiger 2009). Treatments incorporating planning, decision making and self-control strategies appear particularly useful (Schag et al. 2015). Similarly, interventions that target impulsivity may also function to prevent problematic drug use (Conrod, Castellanos-Ryan, and Strang 2010).

Psychoeducation regarding the sedative effects of marijuana may serve as an additional prevention tool. The present study demonstrates that sedative expectancies may be protective in the development of problematic marijuana use. Individuals who expect fewer stimulant effects may be less likely to develop problematic use patterns. Given the present findings, such interventions may be particularly effective for individuals high on impulsivity. Previous "expectancy challenge" studies demonstrate that challenging positive expectancies contributes to a reduction in problematic substance use (Brown 1993; Darkes and Goldman 1993; Dunn, Lau, and Cruz 2000). Interventions that educate marijuana users about the biphasic nature of marijuana and encourage users to attend to the sedative effects of use over the stimulating effects may help address problematic use.

With growing support for the APM, intervention and prevention efforts that combine a focus on impulsivity and expectancies would also be warranted. Future research should continue to examine the APM as it accounts for variance in marijuana use. Similarly, future work should incorporate multifaceted intervention and prevention efforts, emphasizing the role of both impulsivity and expectancies in understanding individual differences in marijuana use; these interventions may be particularly warranted among high-risk populations, such as adolescents (Brook, Balka, and Whiteman 1999; Fergusson, Horwood, and Swain-Campbell 2002).

The present study has limitations related to sampling. Internet access implies basic computer skills and financial resources; thus, the present study may be underrepresentative of socioeconomically disadvantaged marijuana users. Another limitation is the use of a marijuana-legalization group's listserv for recruitment. While this strategy enabled a large sample, it is possible that this group is less likely to report on negative aspects of marijuana use, given its relationship to marijuana legalization efforts. We also acknowledge concerns of bias with this sample, in that there appears to be a higher prevalence of heavy marijuana users in this community comparable to the general population. Conversely, because of this sampling, we were also unable to capture non-users. While this limitation compromises external validity of findings, the sample provided a unique opportunity to apply the APM to a unique sample of frequent, heavy marijuana users who may experience increased rates of marijuana-associated problems.

We examined marijuana use through specific items concerning weekly and monthly use through smoking, which may have limited users from reporting alternative methods of marijuana use and frequency of use over time; however, these items also provided a more precise measure of amount smoked, which is typically not captured in calendar-based self-reports (Johnson and Golub 2007; Mariani et al. 2011). Future research should incorporate additional measures to capture a comprehensive history of marijuana use, particularly if examining expectancies in heavy users.

While the present study offers a novel approach to marijuana expectancies in examining the sedative and stimulant effects of marijuana, further work is needed to validate the adaptation of the Biphasic Alcohol Effects Scale (Martin et al. 1993) in marijuana users. While the present study's focus on stimulant and sedative effects is novel, the survey likely should have included questions regarding strain of marijuana most commonly used, as different strains of marijuana produce different effects. In addition, the study would have been strengthened by either including additional measures of marijuana expectancies that could be clearly classified as positive or negative, or by providing participants with the opportunity to rate identified expectancies as positive or negative. This would reduce the possible confound inherent in focusing on stimulant and sedative expectancies without further insight into how these expectancies may be viewed as positive or negative. Finally, the ethnic makeup of the present sample limits generalizability. Future work should continue to examine the application of the APM to a more diverse sample of marijuana users.

Despite these limitations, the present study offers a novel investigation into the biphasic nature of marijuana intoxication and the role of the APM in explaining variance in marijuana use. Our findings suggest a biphasic response to marijuana similar to established research on alcohol (Scott and Corbin 2014). Additional research is needed to examine this pattern, with particular attention to how the biphasic nature of marijuana shapes expectancies and predicts marijuana use patterns. The findings were promising in demonstrating significant correlations between positive urgency and the types of biphasic expectancies marijuana users endorse. The present study was also novel in its application of the APM to a sample of frequent marijuana users and offers support for the APM in the etiology of marijuana use. Further work is needed to replicate current

findings and further articulate the APM in marijuana use.

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