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Examining the role of impulsivity and expectancies in predicting marijuana use: An application of the acquired preparedness model

By

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Abstract

Impulsivity and substance use covary. Smith’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 (Smith & Anderson, 2001). The present study seeks to examine the relation between impulsivity, marijuana expectancies and marijuana use patterns, adapting the Biphasic Alcohol Effects Scale for marijuana users (Martin, Earleywine, Musty, Perrine & Swift, 1993). This adapted scale measures the sedative and stimulant properties of marijuana. The study focused on a sample of frequent marijuana users (n=3,616) and assessed impulsivity using the UPPS-P, expectancies using the Biphasic Marijuana Effects Scale and also assessed use patterns. Findings suggest that stimulant expectancies predict heavier, more frequent cannabis use than sedative expectancies and that cannabis expectancies vary based on the limb of marijuana intoxication. Examination of Smith’s acquired preparedness model revealed that impulsivity’s link to marijuana use was fully mediated by expectancies.

Keywords: expectancies, impulsivity, marijuana
Introduction

According to the 2012 National Survey on Drug Use and Health, marijuana is the most commonly used illicit substance in the United States with 49% of respondents reporting lifetime marijuana use and 12% reporting past-year use (National Institute of Drug Abuse, 2012). Research demonstrates that frequent, heavy marijuana use tends to predict cannabis-associated problems, and that heavy users are more likely to report respiratory problems as well as difficulty fulfilling role obligations (Fergusson & Boden, 2008; Hall & Degenhardt, 2009; Loflin & Earleywine, 2015). As legislation and public attitudes toward marijuana change, it is important to identify the factors that predict the most problematic use to aid harm reduction.

Research suggests several potential etiological pathways in the development of substance use, but two predominant theories focus on specific personality traits and on psychosocial learning histories (Hayaki et al., 2011). 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 et al., 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. The Acquired Preparedness Model (Smith & Anderson, 2001) integrates these previously disparate theories and proposes a mediational model. This model states that personality traits predispose (prepare) individuals to develop (acquire) beliefs about a substance that influence substance use initiation and maintenance. Specifically, impulsivity contributes to the development of specific expectancies that increase the likelihood of use. To better understand the Acquired Preparedness Model and its relevance to marijuana use, we first provide background on impulsivity and
expectancies as distinct predictors of substance use. Next, we provide a thorough look at research on the acquired preparedness model before introducing the present study.

**Impulsivity**

Impulsivity is broadly defined as an individual’s tendency to engage in erratic or unplanned behavior with little consideration of the consequences). Impulsivity is a multifaceted construct often broken down into three distinct forms: trait impulsivity, impulsive action, and impulsive choice (Mitchell & Potenza, 2014). Several reliable and validated measures of impulsivity further refine the construct into distinct patterns of behavior. The Urgency, Premeditation, Perseverance, Sensation-Seeking (UPPS-P) Impulsive behavior scale divides impulsivity into four subscales (Whiteside & Lynam, 2001). Urgency is characterized by an individual’s tendency to act impulsively when experiencing marked positive or negative affect. Premeditation is an individual’s tendency to reflect on the consequences of a behavior before acting. Perseverance is defined by a capacity for attention or focus during tedious tasks. Finally, Sensation-Seeking is an individual’s tendency to engage in exciting or thrill-seeking behavior.

Impulsivity consistently predicts substance use and abuse. Individual differences in impulsivity are associated with increased use and abuse of alcohol, tobacco, opiates, and cocaine (Mitchell & 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 & Newman, 1993). This attentional bias increases the likelihood of substance use in spite of negative consequences, and explains why many individuals continue to abuse illicit substances despite negative outcomes. Impulsivity is often measured in laboratory settings using delay-discounting tasks, where participants are given the choice between smaller more
Immediate rewards or larger, delayed rewards. Impulsive individuals tend to choose the former, even when the delay for the larger reward is short, and the delayed reward objectively more reinforcing (Mitchell & Potenza, 2014).

On such measures of impulsivity, drug abusers tend to prefer the smaller, immediate rewards suggesting support for the mechanism of dishinhibition. Individuals with prior drug dependence showed significantly more impulsivity than those with no history of illicit drug use (Allen, Moeller, Rhoades & Cherek 1998). Namely, individuals with a history of drug dependence performed more impulsively on a delay-discounting procedure, and had significantly higher scores on four out of five impulsivity questionnaires. In a longitudinal study examining substance use and impulsivity among 457 public school students, high novelty seeking, low harm avoidance, and low reward dependence were significantly associated with substance use (Wills, Vaccaro & McNamara, 1994).

More recent research on particular illicit substances offers support for these earlier findings. In a delay-discounting procedure with cocaine abstinent and cocaine-dependent individuals, demonstrated that both groups behaved equally impulsively and significantly more impulsively than a control group of non-drug users (Heil, Johnson, Higgins & Bickel, 2006). Similarly, cocaine users tend to demonstrate high scores on measures of sensation seeking, trait impulsivity, and positive and negative urgency (Vonmoos et al., 2013; Torres, 2013). Heroin users also display greater impulsive choice in delay-discounting tasks (Nielsen et al., 2012). Individuals with current or past alcoholism, and nicotine use show similar patterns of impulsivity on self-report and behavioral measures (Petry, 2001; Lejuez et al., 2010; Krishnan-Sarin et al., 2007; Ohmura, Takahashi & Kitamura, 2005).
Although impulsivity is generally considered a strong predictor of substance use, this relation is somewhat less understood for marijuana use. Nevertheless, research suggests that impulsivity contributes to variance in cannabis use. In a meta-analysis of thirty-eight studies on UPPS-P impulsivity traits and marijuana use among adolescents, sensation seeking, lack of planning and positive urgency significantly predicted negative marijuana consequences, with moderate effect size (VanderVeen, Hershberger & Cyders, 2016). A significant, positive relation between impulsivity, as measured by the Impulsiveness Subscale of the Eysenck I, and cannabis use frequency has also been observed (Vangsness, Bry & LaBouvie, 2005). Sensation seeking in particular is strongly associated with marijuana use in adults and adolescents. Age-related changes in impulsivity and sensation-seeking significantly predict alcohol, marijuana and cigarette use, such that adolescents showing a more gradual decline in impulsivity use these substances with greater frequency (Knafo, Jaffee, Quinn & Hardin, 2013). In adults, sensation seeking is similarly associated with higher rates of alcohol, tobacco and marijuana use (Trocki, Drabble & Midanik, 2009).

Though somewhat less consistent, research into additional UPPS-P facets of impulsivity shows associations between negative urgency and marijuana use (Pang et al., 2014; Robinson, Ladd & Anderson, 2014), lack of planning and negative marijuana consequences (Caspi, Henry, McGee, Moffitt & Silva, 1995, Churchwell, Lopez-Larson & Yurgelun-Todd, 2010) and lack of perseverance and adolescent marijuana use (Tercek, 2008; Stautz & Cooper, 2014). Additional research is needed to further clarify the role of specific UPPS-P traits and cannabis use.

While consistent 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 studies showing strong associations between impulsivity and drug use, effect
sizes are small to moderate, suggesting other factors at play in the etiology of substance use (VanderVeen et al., 2016). Similarly, research demonstrates that not all impulsive individuals develop problematic substance use patterns, suggesting additional mechanisms likely account for variance in drug use.

**Expectancies**

Outcome expectancy theory, based in social learning perspectives, 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 & Fromme, 2001). A drug’s expected effects predict patterns of use and abuse (Goldman, Brown, & Christiansen, 1987). Drug use expectancies typically 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 & Stetson, 1987). Through direct experience with a substance, expectancies are either confirmed or challenged, with confirmed positive expectancies likely to maintain use (Dunn & Goldman, 1998).

Typically, substances with more stimulating effects are thought to be more reinforcing, thus contributing to more positive expectancies and greater use (Martin et al., 1993). Similarly, substances with more sedating effects are thought to be less reinforcing. A substance can have both stimulating and sedating effects that vary with dosage and time. Generally, 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 typically increase the likelihood of drug use initiation and maintenance (Leventhal & Schmitz, 2006). Negative expectancies tend to reduce the likelihood of drug use (e.g. “I expect to feel lousy the day after...
Research suggests that the direction and strength of expectancies explains variance in drug use (Leventhal & Schmitz, 2006). Strong, positive expectancies tend to predict frequency of use, while negative expectancies are higher among individuals who never initiate use (Gaier & Simmons, 2007; Schafer & Brown, 1991).

Brown (1993) proposed a five-component model of expectancies, which states that: (1) Expectancies are based on cognitions that result from the use of a substance (2) Expectancies function as a link between a stimulus and behavioral outcomes (3) Expectancies are probabilistic (4) Expectancies are a form of memory, accessible at various levels and (5) Expectancies are shaped by learning principles.

A great deal of expectancy research has focused on alcohol use. Positive alcohol expectancies include social confidence, improved cognitive or motor functioning, sexual arousal, physical pleasure, and a reduction in negative affect or distress (Jones et al., 2001). Negative alcohol expectancies include sickness, depressed mood, dizziness, fatigue and risky behavior (Rather & Goldman, 1994). The Alcohol Expectancy Questionnaire is a commonly used measure of alcohol expectancies with a focus on positive expectancies. The AEQ’s six subscales include global positive outcomes, social and physical pleasure, sexual experience, power and aggression, social assertiveness, and relaxation (Leventhal & Schmitz, 2006).

Scores on the AEQ’s subscales have been linked to specific alcohol use patterns. For example, light drinking is associated with global positive expectancies while heavy drinking relates to expectancies of tension reduction, enhanced sexual pleasure, and positive social outcomes (Brown, 1985; Brown, Goldman, Inn & Christiansen, 1980). Generally, drinking behavior is significantly and positively associated with positive expectancies and negatively associated with negative expectancies (Christiansen & Goldman, 1983; Brown, Christiansen &
Goldman, 1987; Fromme, Stroot & Kaplan, 1993). Differences also emerge in examining the expectancies of alcoholics versus non-problem drinkers. Alcoholics and non-problem drinkers differed on nearly every expectancy effect measured (Connors, O’Farrell, Cutter & Thompson, 1986).

Alcohol expectancies are consistently associated with frequency and quantity of alcohol use, though expectancies are a stronger predictor of alcohol use quantity than frequency (Chen, Grube & Madden, 1994; Fromme & D’Amico, 2000). This relation appears especially strong among adolescents. Understanding alcohol expectancies is also promising in identifying the development of problematic use patterns. Research examining alcohol use in adolescents over a two-year period demonstrated that expectancies for improved social functioning and changes in motor functioning accounted for substantial variance in use. In the same study, expectancies for social behavior predicted adolescent’s transition from non-problem to problem drinking over the following 12 months (Christiansen, Smith, Roehling & Goldman, 1989).

To examine the extent to which other drug expectancies develop through learning processes similar to alcohol, Schafer and Brown (1991) examined marijuana and cocaine expectancies and their association with drug use patterns. In a sample of 475 college students, expectancies were strongly associated with marijuana and cocaine use patterns. Nonusers of both drugs endorsed stronger negative expectancies, and frequent users were more likely to endorse positive drug effects. This work also suggested that marijuana expectancies overlap with alcohol expectancies; with participants endorsing social and sexual functioning, tension reduction, cognitive and behavioral problems, and cognitive enhancement as expected effects of marijuana use.
Though the relation between marijuana expectancies and marijuana use patterns is less researched, expectancies do appear to covary with frequency and quantity of use, as well as associated problems. Research examining expectancies among adolescents over three consecutive years, has focused on positive drug expectancies and substance use initiation. Participants asked to describe expected effects of substances and the degree to which they would or would not like each effect demonstrated that participant “liking” of expected effects significantly predicted early substance use initiation and greater rates of use over time (Fulton, Krank & Stewart, 2012). In a longitudinal study of 454 adolescents global positive expectancies were significantly associated with adolescent marijuana use, but not significantly associated with adult marijuana use. Interestingly, expectancies of cognitive-behavioral impairment were significantly negatively associated with adolescent and adult marijuana use. This finding suggests that an absence of negative expectancies may influence substance use outcomes as much as the presence of positive expectancies (Kristjansson, Agrawal Lyskey & Chassin, 2012). Similar associations between expectancies and marijuana use have emerged with a community sample of young women (Hayaki et al., 2010), college students (Bolles, Earleywine & Gordis, 2014; Gaher & Simmons, 2007;), young adults (Brodbeck, Matter, Page & Moggi, 2007), and experienced marijuana users (Simons, Correia & Carey, 2000).

While trends vary, individuals with positive expectancies of marijuana are generally more likely to use the substance, and tend to use greater quantities with greater frequency (Pedersen et al., 2015). Similarly, negative expectancies tend to predict less marijuana use. Positive expectancies of marijuana include stress reduction, increased social competency, and reduced symptoms of depression, anxiety and other psychological symptoms. Negative expectancies include cognitive impairment, memory loss and trouble fulfilling everyday responsibilities. 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 (Martin et al., 1993). Some substances have both stimulant and sedative properties that vary with dosage and time. Previous research has suggested 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 (Earleywine et al., 1993). Further characterizing drug expectancies as stimulant or sedative (in addition to positive or negative) provides a more nuanced understanding of expectancies. While typically considered a depressant, the literature suggests that marijuana also has both stimulant and sedative properties (Block, Erwin, Farinpour & Braverman, 1998). Thus, examinations of the role of marijuana expectancies on use can benefit from examining 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. Research suggests that expectancies mediate the relation between certain risk factors and drug use. In their review of the literature, 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 the included studies examine 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 better understand the nature of expectancies as a mediator in the link between psychosocial risk factors and the development of substance use.

The Acquired Preparedness Model

The Acquired Preparedness Model combines a focus on drug expectancies and impulsivity in a meditational model of drug use (Smith & Anderson, 2001). This model proposes
that impulsivity predicts substance use patterns, but that this relation is mediated by
expectancies. The model suggests that more impulsive individuals are more likely to develop
expectancies about a substance that sustain chronic use (Smith & Anderson, 2001). Specifically, impulsive individuals appear more likely to acquire expectancies that maintain chronic or
problematic use. Similarly, research on this model has demonstrated that impulsivity is
associated with the development of more positive pre-initiation expectancies, increasing the
likelihood of drug use initiation (Smith & Anderson, 2001). Such positive expectancies likely
develop as a result of impulsive individuals’ tendency to attend to the positive, immediate and
rewarding aspects of a stimulus. Thus expectancies or impulsivity alone do not fully account for
variance in substance use patterns. Rather, positive expectancies among impulsive individuals
may trigger a more chronic and potentially problematic pattern of drug use.

The Acquired Preparedness Model (APM) has been studied in alcohol, tobacco and
marijuana use. Positive alcohol expectancies partially mediate the relation between disinhibition
and drinking in black and white men (McCarthy, Miller, Smith & Smith, 2001). In a follow-up
study, full mediation by positive expectancies in the relation between disinhibition and drinking
was observed in men, but not in women. Notably, these authors operationalized disinhibition
using measures of neuroticism and extraversion rather than an established measure of
impulsivity. Focusing specifically on women, Anderson, Smith, and Fischer (2003) examined the
APM in alcohol use with a sample of 291 college women. These authors incorporated 3 specific
indicators of disinhibition (sensation seeking, novelty seeking, and impulsivity) and used the
short form of the AEQ to assess alcohol expectancies. Findings revealed that both positive and
negative alcohol expectancies partially mediated the relation between disinhibition and alcohol
use. Supporting previous findings, higher levels of disinhibition predicted lower levels of negative alcohol expectancies (Anderson et al., 2003).

While many applications of the APM have focused on cross sectional data, Settles, Cyders and Smith (2010) examined the model in a longitudinal study of drinking risk in 418 first year college students. Focusing specifically on positive and negative urgency, the authors measured urgency, alcohol expectancies, drinking motives and drinking styles at three points during the first year of college. The authors used structural equation modeling to test the APM in this sample. Positive urgency at time point 1 significantly predicted quantity of alcohol intake at time point 3, and this relation was mediated by expectancies at time point 2 (Settles et al., 2010). 56% of the variance in drinking quantity at wave 3 could be explained by this model. Negative urgency at time point 1 similarly predicted quantity of alcohol consumption at time point 3, but this relation was mediated by different expectancies. Specifically, negative urgency predicted coping expectancies rather than positive expectancies.

The APM has also been applied and supported in explaining variance in tobacco use (Doran et al., 2013; Combs, Spillane, Caudil, Stark & Smith, 2012). In examining the APM in college students, Doran et al. (2013) focused on smoking initiation patterns among 400 students with no history of smoking. This longitudinal design included a baseline assessment followed by quarterly assessments for 15 months. Investigators measured smoking expectancies and impulsivity at baseline using the Smoking Consequences Questionnaire and UPPS impulsiveness questionnaire respectively. Smoking behavior was assessed at each follow-up. Sensation seeking significantly and directly predicted smoking initiation. Negative urgency, lack of premeditation and lack of perseverance did not emerge as significant, direct predictors of smoking initiation. Mediation analysis confirmed that the effects of sensation seeking and negative urgency were
mediated by positive reinforcement and negative reinforcement expectancies, supporting the APM (Doran et al., 2013).

To date, three studies have examined the APM in marijuana users. Vangsness et al. (2005) tested the APM in a sample of 248 college students. The authors measured impulsivity, marijuana expectancies and marijuana use. The authors assessed impulsivity using the impulsivity subscale of the Eysenck I, and assessed expectancies using Comprehensive Effects of Marijuana (CEOM) scale, adapted from a previous measure of alcohol expectancies. Findings demonstrated partial mediation of expectancies in the relation between impulsivity and marijuana use frequency. Specifically, impulsive individuals endorsed fewer negative expectancies and used marijuana more frequently. Contrary to study hypotheses and previous findings with alcohol users, positive expectancies did not mediate the relation between impulsivity and marijuana use. Limitations of this study stem from inclusion of participants with no prior marijuana use as the risk process for marijuana use initiation may differ from marijuana use maintenance.

Hayaki et al. (2010) tested the APM in a sample of community-recruited women who endorsed marijuana use. These authors assessed marijuana use frequency, marijuana-related problems, marijuana dependence, impulsivity, and marijuana expectancies. The authors also assessed marijuana refusal self-efficacy, which examines an individuals’ perceived ability to resist a substance in high-risk situations. Findings revealed that impulsivity was associated with all three marijuana outcomes. Supporting the APM, positive expectancies fully mediated the relation between impulsivity and frequency marijuana use. However, positive expectancies did not mediate the association between impulsivity and marijuana problems or marijuana dependence. Interestingly, negative expectancies mediated the relation between impulsivity and all three marijuana outcomes, though the direction of mediation varied by outcome. Impulsive
individuals with negative marijuana expectancies reported lower overall use compared to individuals with positive expectancies, yet endorsed higher rates of marijuana-associated problems and marijuana dependence. This finding suggests that perhaps impulsive individuals with negative marijuana expectancies represent a unique and vulnerable population.

Bolles et al. (2014) also sought to apply the APM to marijuana users and to clarify previous findings. The authors examined the APM in nearly six thousand regular marijuana users, measuring impulsivity using the Impulsive Sensation Seeking (ImpSS) scale and expectancies using the Marijuana Effect Expectancy Questionnaire (MEEQ). The authors also measured quantity of marijuana use per month (in ounces). Findings revealed that expectancies partially mediated the relation between impulsivity and marijuana use. Impulsivity also significantly moderated the relation between expectancies and use, with expectancies showing a particularly large, positive association with use in those who are high on impulsivity.

There is a clear need for additional research applying the APM to marijuana users. The above findings vary in measurement of variables, sampling techniques, and degree of mediation observed. Nevertheless, they provide general support for the relevance of the APM in marijuana users. Given the prevalence of marijuana use, and the evidence for the APM with other substances, further research can help articulate the combined role of impulsivity and expectancies in predicting problematic marijuana use.

The Present Study

The present study examines the manner in which marijuana expectancies predict use patterns, and categorizes the effects of marijuana as either stimulant or sedative. In adapting the Biphasic Alcohol Effects Scale, we sought to further elucidate the stimulant and sedative properties of marijuana, and determine how these effects predict marijuana consumption. The
present study examines whether marijuana users expect a biphasic response to the substance, with stimulant effects occurring on the ascending limb of intoxication and sedative effects occurring on the descending limb of intoxication. In assessing these effects, we also sought to apply the Acquired Preparedness Model to a sample of frequent marijuana users. Specifically, we examined the role of positive urgency, a facet of impulsivity defined by a tendency to engage in risky or impulsive behaviors during positive mood states, as a predictor of marijuana use. We sought to evaluate whether individuals with elevated scores on measures of positive urgency were more likely to develop heavy marijuana use patterns, and in what way expectancies mediate this relation. We anticipated that participants would expect a biphasic response to marijuana similar to alcohol. Additionally, we hypothesized that as positive urgency increases, so will more frequent and heavy marijuana use, and that this variance in use patterns can be explained by variance in marijuana expectancies.

Methods

Participants

Participants were recruited through the email listserve of the National Organization for the Reform of Marijuana Laws. Informed consent was obtained prior to survey completion. An initial sample of four thousand and eighty-six participants gave consent to complete the survey. One hundred and sixty eight participants were removed for failure to complete the second administration of the BMES. Three hundred and two participants were removed for inadequate responses to two infrequency measures included to assess careless responding. Three thousand six hundred and sixteen participants were included in the present analyses. Thirty-one percent (1104) of the sample was female and sixty-eight percent (2452) was male. The mean age for this sample was 46.93 (SD=14.6). 86% percent (3,119) of participants 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%). Education level varied, with most participants (33%) reporting “some college” and many (22%) reporting having obtained a bachelor’s degree. A large portion of participants (45%) reported full time employment, with an additional 17% reporting that they were retired, 16% reporting lack of employment due to disability and 10% reporting part-time employment. Full sample characteristics can be found in Table 1.

Measures

Subjects completed several measures within the online survey. After completing questions regarding age, race and ethnicity, gender, education and employment, the measures were presented to subjects in the order below:

**Quantity/Frequency of Marijuana Use:** Participants were asked whether they’d used marijuana in the past month. Participants were next asked to report how many days per month and per week they typically use marijuana, how many joints they smoke each week, and how many ounces of marijuana they use each month. Participants were also asked to rate from “less than a quarter ounce” to “over 4 ounces” on a 6-point likert scale, the amount of cannabis they used each week. Finally, participants were asked to rate how high they felt after a typical smoking session, on a six-point scale ranging from 0 (not at all) to 6 (extremely).

**Positive Urgency:** The UPPS-P is used to measure impulsive behavior, with emphasis on four pathways of impulsivity. For the present analysis, we were interested in examining the facet of impulsivity known as positive urgency, which measures an individual’s tendency to engage in risky or impulsive behaviors when experiencing a positive emotional state. 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). Cronbach’s alpha estimate of internal consistency for this scale was .902 suggesting high internal consistency.

**Biphasic Marijuana Effects Scale (Ascending and Descending limbs):** The Biphasic Alcohol Effects Scale was adapted for marijuana users. This scale consists of 14 items and measures the stimulant and sedative effects of marijuana. Participants are instructed to choose between 0 (not at all) and 10 (extremely) to rate the anticipated effects of marijuana. Stimulant items on the BMES include: elated, energized, excited, stimulated, up, talkative and vigorous. Sedative items include: difficulty concentrating, down, heavy head, inactive, sedated, slow thoughts and sluggish. Participants were instructed to complete 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 such that higher overall scores on the BMES suggested more sedative expectancies and lower scores suggested more stimulant expectancies. Cronbach’s alpha estimate for both administrations of the BMES was .82, 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. On the item measuring intoxication during a typical smoking session, participants had a mean score of 4.48 (SD=1.06).
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). We performed parametric tests using this transformed variable, but report means and SDs of the untransformed variable to necessitate easier interpretation.

Biphasic Marijuana Effects Scale

Mean scores on the BMES varied based on limb, with participants reporting significantly higher scores 2 hours following use of marijuana as 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 ascending to descending limb. Means and standard deviations for each limb can be found in Table 2.

Relation to Marijuana Consumption

Bivariate correlations revealed relations between mean scores on each limb of the BMES and marijuana use. BMES scores correlated significantly with the amount of marijuana used per month. For both limbs of intoxication BMES scores were 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 stimulant expectancies predict increased marijuana use while sedative expectancies predict 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, and lower BMES scores suggest more stimulant marijuana expectancies. This finding suggests that higher scores on positive urgency are associated with more stimulant, less sedative expectancies.

**Acquired Preparedness Model**

Hayes’ PROCESS macro was used to perform a mediation analysis. In step 1 of the mediation 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 mediation process showed that the mediator (expectancies), controlling for positive urgency, was significant for both limbs of intoxication (Ascending: $b = -.11, p < .05$; Descending: $b = -.10, p < .05$). Step 4 of the mediation process showed that, controlling for the mediator (expectancies), positive urgency was not a significant predictor of marijuana use ($b = .50, p = .50$). A Sobel test was performed and found full mediation in the model (Ascending: $z = -.10, p < .05$; Descending: $z = -.10, p < .05$). It was found that expectancies fully mediated the relation between positive urgency and marijuana use.

**Discussion**

The relation between drug expectancies and an individual’s patterns of use has been studied extensively, with particular emphasis on the stimulant and sedative properties of a drug as predictors of use (Martin et al., 1993). Impulsive individuals appear more likely to use drugs, and develop more chronic patterns of use. The mechanism of disinhibition posits a link between impulsivity and positive drug expectancies, which sustain more chronic and possibly problematic use (Patterson & Newman, 1993). Similarly, The APM proposes that the relation between
impulsivity and substance use is mediated by expectancies.

The present study sought to examine the association between impulsivity, expectancies and cannabis use patterns among frequent marijuana users. We also sought to assess the stimulant and sedative properties of marijuana and to examine the role of such properties in predicting expectancies and use patterns. In order to address the stimulant and sedative properties of cannabis, the present study adapted the Biphasic Alcohol Effects Scale for marijuana. To measure impulsivity, the present study utilized the positive urgency subscale of the UPPS-P.

Findings from the present study confirmed our hypotheses that marijuana expectancies predict patterns of use and that positive urgency, a facet of impulsivity, contributes to marijuana expectancies. Individuals with sedative expectancies reported less frequent marijuana use than individuals with stimulant expectancies. Also supporting our hypothesis, individuals with greater positive urgency were significantly more likely to endorse stimulant cannabis expectancies for both limbs of intoxication. Alternately, individuals with higher mean scores of positive urgency were less likely to report sedative cannabis expectancies.

A mediation model was tested to examine the role of acquired preparedness in predicting cannabis use. The APM proposes that expectancies mediate the relation between impulsivity and substance use. This model applied to the current data, revealed full mediation, such that expectancies on the ascending and descending limbs of intoxication mediate the relation between impulsivity and quantity of cannabis used per month. That is, individuals who were higher on impulsivity, reported less sedative expectancies, and in turn used marijuana more often. This finding held true for both the ascending and descending limb of marijuana intoxication. This finding provides insight into the nature of the etiology of marijuana use, and offers support for the APM among marijuana users.
Taken together, the findings suggest important implications for treatment of marijuana use disorder and prevention of problematic marijuana use. With growing evidence that impulsivity contributes to the development of expectancies that maintain use, targeting impulsivity is a clear point of intervention. Reductions in impulsivity over time are associated with increased psychosocial functioning and decreased problematic alcohol use among alcoholics (Blonigen, Timko & Moos, 2013). Neuroimaging research has demonstrated that Naltrexone, a medication used to treat alcoholism, appears to increase activity in the orbitofrontal cortex during decision making tasks, decreasing the tendency for impulsive choice (Crews & Boettiger, 2009). Impulsivity-based interventions have also demonstrated utility in reducing binge eating, a behavior often compared to other addictive behaviors, and which the APM has been applied to (Schag et al., 2015; Combs, Smith, Flory, Simmons & Hill, 2010). Treatment that incorporates strategies aimed at planning, decision making and self-control appear particularly useful (Schag et al., 2015). Considering the developmental course of impulsivity, adolescents may be particularly vulnerable to problematic marijuana use (Crews et al., 2009). Therefore, interventions aimed at targeting impulsivity as a means of reducing marijuana use may be quite beneficial for adolescents and emerging adults. Similarly, interventions that target impulsivity may function to prevent or reduce problematic drug use. Adolescents exposed to an intervention for impulsivity, focusing on cognitive restructuring and problem solving skills, demonstrated reductions in substance use over the two years that followed (Conrod, Castellanos & Strang 2010). Together, such findings support the idea that interventions targeting impulsivity function to reduce or prevent problematic drug use. Still, additional research is needed to elaborate the impact of impulsivity-based interventions among marijuana users specifically.
Another prevention approach may involve psychoeducation for vulnerable populations regarding the sedative effects of marijuana. The present study demonstrates that sedative expectancies may be protective in the development of frequent, heavy marijuana use. Thus, individuals who expect fewer stimulant effects, may be less likely to develop problematic use patterns. Given present findings, such interventions may be particularly effective for individuals high on impulsivity. Previous “expectancy challenge” studies have demonstrated that challenging positive alcohol expectancies contributes to a reduction in heavy drinking among college students (Darkes & Goldman, 1993; Dunn, Lau & Cruz 2000). Similarly, changing expectancy content, changing expectancy strength and value, and enhancing competing expectancies appear to bolster intervention efforts. Strategies that increase self-monitoring, provide opportunities for new learning, and offer expectancy-related education may be especially useful (Brown, 1993). For example, research with alcohol has demonstrated that positive expectancies relate to the ascending limb of the blood alcohol curve. Therefore, information about the biphasic nature of marijuana may challenge expectancies and provide an opportunity for new learning. Perhaps an intervention that educates marijuana users about the biphasic nature of marijuana, and encourages users to attend to the sedating effects of marijuana rather than the stimulating effects would help to address problematic use.

The present findings have limitations related to sampling. Collecting survey data via the Internet has benefits and costs. Data are mixed regarding the manner in which Internet versus in-person data collection influences self-reporting. However, there is research to suggest that completing surveys on the Internet fosters a greater sense of anonymity, perhaps leading to more candid and honest responses (Reips, 2002; Rhodes, Bowie & Hergenrather, 2003). With substance use research especially; respondents may value this sense of anonymity in reporting on
illegal or controversial behavior. Since Internet access implies basic computer skills and perhaps financial resources, the present study may be limited and under-representative of socioeconomically disadvantaged marijuana users. Another limitation resides in our use of a marijuana-legalization group’s list serve for recruitment purposes. While this strategy enabled a relatively large sample, it’s possible that this group is biased in its reporting on the negative aspects of marijuana use given relationship to marijuana legalization efforts. One potential limitation lies in the use of mediation analysis in a cross-sectional data set. However, this decision appeared justified in considering positive urgency as pervasive personality trait that precedes the development of drug expectancies.

Despite these limitations, the present study offers a novel investigation into the biphasic nature of marijuana intoxication, and the role of acquired preparedness in explaining variance in cannabis use. Findings from the present study suggest a biphasic response to marijuana similar to established research on alcohol. Additional research is needed to further examine this pattern, especially in regard to how this biphasic response shapes expectancies and predicts cannabis use patterns. Similarly, the present study is the first of its kind to examine a specific facet of impulsivity, positive urgency, in its relation to marijuana use. Findings were promising in demonstrating significant correlations between positive urgency and the types of expectancies (stimulant vs. sedative) marijuana users tend to endorse. The present study was also novel in its application of the acquired preparedness model to a sample of frequent cannabis users. The present study 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.
References


smoking cessation program for adolescent smokers. *Drug and alcohol dependence, 88*(1), 79-82.


Table 1  
*Characteristics of Study Sample*

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<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
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<td>Female</td>
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<tr>
<td>Cannabis use per month (ounces/month)</td>
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<td>Cannabis use per week (days/week)</td>
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<td>Joints per week</td>
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<td>Intoxication</td>
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### Table 2

*Table of Correlations*

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<td>3. Positive Urgency</td>
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<td>3.20 (1.68)</td>
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*Note.* All correlations significant at the 0.01 level; Marijuana Use: Ounces of Marijuana used per month.

### Table 3

*Normal Theory Test*

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<td>Descending</td>
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<td>Direct effect of impulsivity on marijuana use (c path)</td>
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<tr>
<td></td>
<td>.62</td>
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