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Expectancies and Self-Efficacy Mediate the Effects of Impulsivity on Marijuana Use Outcomes: An Application of the Acquired Preparedness Model

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Abstract

This study tests the acquired preparedness model (APM) to explain associations among trait impulsivity, social learning principles, and marijuana use outcomes in a community sample of female marijuana users. The APM states that individuals with high-risk dispositions are more likely to acquire certain types of learning that, in turn, instigate problematic substance use behaviors. In this study, three domains of psychosocial learning were tested: positive and negative marijuana use expectancies, and marijuana refusal self-efficacy. Participants were 332 community-recruited women aged 18-24 enrolled in a study of motivational interviewing for marijuana use reduction. The present analysis is based on participant self-reports of their impulsivity, marijuana use expectancies, marijuana refusal self-efficacy, marijuana use frequency, marijuana use-related problems, and marijuana dependence. In this sample, impulsivity was significantly associated with marijuana use frequency, marijuana-related problems, and marijuana dependence. Results also indicate that the effect of impulsivity on all three marijuana outcomes was fully mediated by the three principles of psychosocial learning tested in the model, namely, positive and negative marijuana expectancies, and marijuana refusal self-efficacy. These findings

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Contributors

Michael Stein designed the larger research study from which these data were derived and was the recipient of the grant that funded this larger study. Jumi Hayaki reviewed the literature for this manuscript and wrote all but the analysis plan and the first draft of the Results section. Debra Herman (Project Manager and Clinical Coordinator) contributed to the development of the intervention manual, coordinated supervision, and conducted 50% of the interventions. Claire Hagerty (Senior Research Assistant) screened, interviewed, and followed participants, and managed the database. Marcel de Dios contributed to the initial planning of the manuscript and provided conceptual input throughout its preparation. Bradley Anderson conducted the statistical analyses and wrote the analysis plan and first draft of the Results section.
All authors contributed to and have approved the final manuscript.

Conflict of Interest

All authors declare that they have no conflicts of interest.

lend support to the APM as it relates to marijuana use. In particular, they extend the applicability of the theory to include marijuana refusal self-efficacy, suggesting that, among high-impulsives, those who lack appropriate strategies to resist the temptation to use marijuana are more likely to exhibit more frequent marijuana use and use-related negative consequences.

Keywords

marijuana; acquired preparedness; impulsivity; social learning

1. Introduction

1.1. Marijuana use among young females

Marijuana is currently the most commonly used illicit drug for individuals aged 12 and above (Substance Abuse and Mental Health Services Administration [SAMHSA], 2009). Even at lower levels, acute and chronic marijuana use contributes to many well-documented physical, mental, and social problems (for one review, see Hall & Babor, 2000). Marijuana use prevalence rates increase from 6.7% among 12-17 year olds to 16.5% among 18-25 year olds (SAMHSA, 2009). Evidence of marijuana use among young persons is especially disturbing in light of the association between earlier age of onset and the later development of substance abuse and dependence (Grant & Dawson, 1998; Lynskey et al., 2003; SAMHSA, 2009).

Among young persons, females may be especially susceptible to the negative consequences of marijuana use. Although male marijuana users outnumber their female counterparts (Young et al., 2002), recent evidence suggests that the proportion of female users has increased (Greenfield & O'Leary, 1999; SAMHSA, 2009). The greater prevalence of illicit drug use among males may partly reflect greater initial opportunity; given access, sex differences in drug use onset are minimized (Van Etten, Neumark, & Anthony, 1999). The growing rates of marijuana use among young females, then, may indicate more initial opportunities than in the past. Some researchers have also argued that, once the transition to drug use has occurred, female marijuana users may experience unique adverse effects, such as those related to risky sexual behavior (Poulin & Graham, 2002) and reproductive health (Greenfield, Manwani, & Nargiso, 2003). Due to the higher prevalence rates of drug use among males, studies of young substance abusers have not adequately enrolled women in equal numbers (Brady & Randall, 1999). Thus, young female marijuana users represent a neglected, yet growing and perhaps especially vulnerable, population.

1.2. The acquired preparedness model

The substance use literature has historically presented two prominent, yet independent, lines of research regarding the etiology and maintenance of problematic substance use: one that underscores trait personality and another that underscores psychosocial learning. Personality traits considered explanatory of the onset and continuation of substance use include impulsivity, sensation or novelty seeking, and disinhibition, all of which predict increased consumption and later negative use-related consequences across a variety of substances (for one review, see Moeller & Dougherty, 2002). However, as many researchers have argued, disposition alone cannot sufficiently explain why some individuals high on a risky personality trait misuse substances and others do not (Anderson, Smith, & Fischer, 2003; Settles, Cyders, & Smith, 2010). In contrast, psychosocial learning describes problematic substance use as the result of observation and prior experience, thus explaining why two similar personalities could engage in different courses of behavior. However, because traits are in part genetically derived and/or may develop early in life, they may actually influence the type of learning an individual subsequently acquires. It is likely that both disposition and learning theories are necessary, but neither alone is sufficient, to explain the onset and course of problematic substance use. The acquired preparedness model (APM) represents one recent attempt to integrate these two explanations.

According to the APM, individuals who are high on a risky personality trait are predisposed (*prepared*) to learn (*acquire*) certain beliefs and expectations regarding substance use, which in turn influence their behavior (McCarthy, Kroll, & Smith, 2001a). The APM thus posits a meditational model in which high-risk traits, when activated by certain patterns of psychosocial learning, produce maladaptive substance use outcomes. One trait with arguably the greatest relevance to substance use problems is disinhibition, the tendency to focus more on rewards than punishments (cf. Anderson et al., 2003), which may explain why many substance abusers continue using despite admittance of potential or real negative consequences. Indeed, this characteristic is considered a defining feature in many nosological systems, such as the substance dependence diagnostic category in the current version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994). Thus, when disinhibited individuals learn about substance use, they do so in such a way that emphasizes its desirable, not undesirable, effects. In the language of the APM, then, such individuals are more likely to be influenced by positive, not negative, expectancies regarding substance use because they emphasize its pleasurable effects (Smith & Anderson, 2001).

Much of the extant empirical evidence in support of the APM comes from the alcohol literature and has tended to study college students (e.g., Anderson et al., 2003; Fu, Ko, Wu, Cherng, & Cheng, 2007; Han & Short, 2009; McCarthy et al., 2001a; McCarthy, Miller, Smith, & Smith, 2001b), though some studies have extended findings to adolescents (e.g., Barnow et al., 2004; Urbán, Kökönyei, & Demetrovics, 2008). Trait disinhibition has been operationalized in a variety of ways, using measures of impulsivity, sensation seeking, and, most recently, trait urgency. Because the APM stipulates that the endorsement of positive expectancies marks the psychosocial learning pattern characteristic of the trait disinhibited individual, many applications of the model have only tested this one domain. Results have consistently validated the APM, with positive expectancies either fully or at least partially mediating the effect of disinhibition on a variety of alcohol use outcomes, including consumption quantity and frequency, drinking styles, and alcohol-related problems. In one rare prospective study of first-year college students, Settles et al. (2010) found that positive expectancies endorsed at the beginning of the academic year mediate the association between positive trait urgency, a dimension of disinhibited personality, and alcohol consumption by the end of that year.

A few studies have also considered negative expectancies, with mixed results. In one test of the APM with college females, Anderson et al. (2005) found that both positive and negative expectancies partially mediate the link between disinhibited personality and alcohol use. In contrast, other studies have found that the meditational pathway through positive expectancies is substantively stronger than that through negative expectancies (Urbán et al., 2008) or have failed to demonstrate that negative expectancies mediate the association (Fu et al., 2007). To the extent that negative expectancies measure awareness of the negative consequences associated with substance use, *low* levels of their endorsement should, in theory, be consistent with trait disinhibition and, could in turn, mediate the pathway to substance use behavior. Alternatively, it is possible that *high* levels of endorsement among problematic users could indicate continued use despite knowledge of its negative consequences. However, findings regarding the role of negative expectancies in the APM thus far have been inconsistent at best.

The apparent utility of (positive) substance use expectancies in representing the psychosocial learning component of the APM notwithstanding, some researchers have suggested that psychosocial learning theories of substance use move beyond this single domain (Dijkstra, Sweeney, & Gebhardt, 2001). To this end, some APM studies have incorporated other aspects of substance use related learning, such as drinking motives (Settles et al., 2010) or social influence, defined as peer delinquency in one instance (Barnow et al., 2004). Another dimension of psychosocial learning that has yet to be studied in connection with the APM is self-efficacy, or confidence in one's ability to engage in a particular behavior. Self-efficacy constitutes a key component of Bandura's (1977) social learning theory that is considered profoundly to influence whether an individual succeeds in attaining a particular behavioral goal. Self-efficacy is of particular relevance to substance abuse because successful recovery is thought to depend in part on a person's confidence in their ability to resist the temptation to use substances in the face of a trigger or high-risk situation. Increasing self-efficacy forms a critical mechanism in many forms of substance abuse treatment (Miller & Rollnick; 2002; LaChance, Feldstein Ewing, & Hutchinson, 2009) and is associated with many post-treatment outcomes including relapse (Ramo, Anderson, Tate, & Brown, 2005) and long-term abstinence (Burleson & Kaminer, 2005; Litt, Kadden, Kabela-Cormier, & Petry, 2008). Yet, despite the well-documented relevance of self-efficacy to substance use outcomes, to date, no direct test of the APM has yet included self-efficacy in its analysis.

Although most studies on the APM have examined alcohol use, more recently, researchers have applied the APM to non-alcohol substances such as cigarette smoking (e.g., VanderVeen, Cohen, Trotter, & Collins, 2008). To our knowledge, only one study has applied the model to marijuana use. In this study, researchers examined the mediating effect of positive and negative expectancies on the association between trait impulsivity and level of marijuana use in a sample of 337 college males and females (Vangsness, Bry, & LaBouvie, 2005). Results indicated that negative, not positive, expectancies partially mediated this association, a finding that is somewhat at odds with reports from the alcohol literature. This apparent discrepancy may be due to a variety of factors. First, this undergraduate sample included some individuals who had never used marijuana. It is possible that the risk process for substance use works differently for initiation versus maintenance. In addition, past year level of use was defined here on a Likert scale from 0-9 (with 0 = never used, 9 = used more than once a day); this primary outcome variable may not have provided sufficient specificity. Another possibility is that the risk process varies across substance classes. The authors argue that negative expectancies may serve a protective function in the initiation and continued use of marijuana. It is possible that this function, though perhaps not necessarily unique to marijuana, may be particularly pronounced with this substance, or perhaps prominent enough as to override the role of positive expectancies. However, because the Vangsness et al. (2005) study is, to our knowledge, the only known previous application of the APM to marijuana use, this remains an empirical question.

1.3. The present study

The purpose of this study was to test the APM in a sample of young female community-recruited marijuana users. Unlike the only previous published study to test the APM for marijuana use (i.e., Vangsness et al., 2005), which used a college sample (many participants of whom were naïve to marijuana use), this study recruited a community sample of experienced, current marijuana users. This study further sought to extend prior research on the APM in the following ways: (a) Unlike prior tests of the APM (with alcohol) that have not consistently included both positive and negative expectancies, this study also examined negative expectancies; (b) In addition to substance use expectancies, this study additionally examined refusal self-efficacy in order to bring greater breadth to the role of psychosocial learning in the model; (c) This study provided a more comprehensive picture of the possible substance-related outcomes in the risk model by testing not only marijuana use frequency but also marijuana-related negative consequences and a validated index of clinical severity, namely, marijuana dependence; (d) The study tested the APM for marijuana use in young adult women, a historically understudied population of marijuana users.

This study had the following hypotheses: (1) In this sample, impulsivity would be positively and significantly associated with the three marijuana-related outcomes: marijuana use frequency, marijuana problems, and marijuana dependence. (2) The effect of impulsivity on these marijuana outcomes would be mediated by three domains of psychosocial learning: positive and negative marijuana use expectancies, and marijuana refusal self-efficacy.

2. Method

2.1. Participants

Participants were women aged 18-24 years recruited from the community for a larger health behavioral study examining marijuana use and sexual risk. Between 1/2005 and 5/2009, 1728 women completed a brief screening questionnaire; eligibility criteria included at least monthly marijuana use in the past 3 months, sexual activity in the past 3 months, absence of pregnancy, ability to speak English, and willingness to provide information. Of the 545 women deemed eligible for the study from the screen, 178 women either refused to enroll or became unavailable. Enrollees and non-enrollees did not differ statistically on age, racial background, or 90-day marijuana use frequency. Of the 367 women who provided informed consent, 35 were deemed ineligible for the study during the baseline interview, leaving a final sample of 332 women. Study approval was obtained from the Butler Hospital Institutional Review Board, and a Certificate of Confidentiality was obtained from the federal government for further participant privacy. Full details of the study recruitment procedure have been published elsewhere (Hayaki et al., 2010). The current analysis uses data collected at the baseline interview.

2.2. Measures

2.2.1. Demographic variables and marijuana use history—Participants self-reported their race, level of education, and age of first marijuana use.

2.2.2. Impulsivity—Trait impulsivity was measured using a 5-item measure developed by Cherpitel (1993). This brief measure was derived from a longer version that had previously been used in national alcohol surveys and that demonstrates good internal consistency reliability (Cronbach's alpha = .80). Items are scored from 1-4 and are summed to create the total score.

2.2.3. Marijuana use expectancies—Marijuana use expectancies were measured using the 48-item Marijuana Effect Expectancies Questionnaire (MEEQ; Schafer & Brown, 1991). The MEEQ assesses three positive (Relaxation/Tension Reduction; Social/Sexual Facilitation; Perceptual/Cognitive Enhancement) and three negative (Cognitive/Behavioral Impairment; Craving/Physical Effects; Global Negative Effects) expectancy domains that each load onto a lower-order subscale containing 6-10 items. Each item is scored on a 5-point Likert scale (from 1 = disagree strongly to 5 = agree strongly), and subscales are calculated as sums of the items. The three positive and three negative subscales are combined to create two higher-order Positive and Negative Expectancy subscales. The overall scale has good psychometric properties, including good reliability and good convergent and discriminant validity (Aarons et al., 2001). In this study, only the higher-order Positive and Negative Expectancy subscales were used.

2.2.4. Marijuana refusal self-efficacy—Refusal self-efficacy was measured using an 8-item version of the original 100-item Situational Confidence Questionnaire (SCQ; Annis & Graham 1998). Each item on the Brief SCQ (BSCQ) asks participants to rate a high-risk situation in terms of their confidence in their ability to resist using substances, on a scale from 0% ("not at all confident") to 100% ("totally confident"). The BSCQ has been shown to be a reliable substitute for the original measure (Breslin, Sobell, Sobell, & Agrawal, 2000). For the purpose of this study, all items on the original alcohol-related BSCQ were reworded so as to assess marijuana refusal self-efficacy. The total score reflects an average of individual item scores.

2.2.5. Marijuana use frequency—Marijuana use in the 90 days prior to the interview was measured using the Timeline Followback (TLFB; Sobell & Sobell, 1995).

2.2.6. Marijuana use problems—Problems associated with marijuana use were assessed using the Marijuana Problems Scale (MPS; Stephens, Roffman, & Curtin, 2000; Stephens, Roffman, & Simpson, 1994), a self-report instrument that asks participants to endorse 19 marijuana-related problems on a 3-point scale ranging from 0 (no problem) to 2 (serious problem). The total score is calculated as a sum of scores on all 19 items (range 0-38).

2.2.7. Marijuana dependence—Participants reported their marijuana dependence symptoms on the Substance Use Disorders section of the Structured Clinical Interview (SCID-I; First et al., 2002) for the DSM-IV (American Psychiatric Association, 1994). For the purpose of this study, marijuana dependence was coded as a dichotomous variable that indicated whether the participant met criteria for the disorder (3 or more dependence symptoms endorsed).

2.3. Analytical method

We present means and standard deviations to describe the characteristics of the sample. Product-moment correlations are presented to summarize bivariate associations among all variables included in multivariate models. Our primary model is a fully-recursive just-identified structural equation model (SEM). Exogenous variables include race, education, age of initial marijuana use, and impulsivity. Our primary substantive interest is on the indirect effects of impulsivity on marijuana outcomes via positive marijuana expectancies, negative marijuana expectances, and marijuana refusal self-efficacy. Although several coefficients are not statistically significant and over-identified models estimating fewer parameters would provide adequate statistical fit with the observed data, we did not engage in post hoc model fitting. Motivated by theoretical considerations, we also estimated a model in which the effect of impulsivity on all three marijuana outcomes was fully mediated by marijuana effects expectancies and marijuana self-efficacy.

MacKinnon et al. (MacKinnon, Lockwood, & Williams, 2004) evaluated alternative methods for estimating the confidence limits of specific indirect effects and recommended the use of bias-corrected bootstrap resampling. Bootstrapping requires few a priori assumptions regarding underlying distributions and provides a robust method for estimating confidence intervals and standard errors when samples are small or when usual model assumptions are unrealistic (Bollen & Stine, 1990). We used bias-corrected bootstrap with 5,000 resamplings to estimate 95% and 99% confidence intervals for all estimated model parameters. Parameter estimates with 95% (99%) confidence intervals not including 0 were considered statistically significant at the .05 (.01) levels. To describe the SEM fully we present unstandardized coefficients, the associated 95% confidence interval, and fully standardized (e.g., path) coefficients. We limit our discussion to the latter. We also present all implied specific indirect effects. Although tests of significance were based on 95% confidence intervals estimated by bias-corrected bootstrap, we present and discuss only the fully standardized indirect effects.

3. Results

Age ranged from 18-24 with a mean of 20.47 (± 1.7) years. About 67.7% (n = 225) were Caucasian, 11.5% (n=38) were Hispanic, 10.5% (n = 35) were African American, and 10.2% (n=34) were of other racial or ethnic origins. The mean age at which participants started using marijuana was 14.7 (± 2.2) years. On average, participants reported using marijuana on 51.5 (± 30.6, median = 52) of the 90 days prior to baseline assessment. Just over half (52.7%) met diagnostic criteria for marijuana abuse, and 39.6% (n=131) met criteria for dependence. The mean marijuana problem severity score was 4.9 (± 4.7); 36 (10.8%) participants did not endorse any problems.

Product-moment correlations, means, and standard deviations for all variables included in multivariate models are given in Table 1. We note that impulsivity was significantly correlated with both positive ($r = .33$, $p < .05$) and negative ($r = .20$, $p < .05$) marijuana effects expectancies and inversely associated with marijuana self-efficacy ($r = -.18$, $p < .05$). Impulsivity also exhibited statistically significant zero-order correlations with marijuana use days ($r = .12$, $p < .05$), marijuana problem severity ($r = .22$, $p < .05$), and marijuana dependence ($r = .17$, $p < .05$).

Unstandardized and standardized parameter estimates for the just-identified fully recursive structural equation model are reported in Table 2. Figure 1 provides a graphic summary of the significant effects in this model. To facilitate discussion we describe only the fully standardized coefficients and, because of theoretical considerations, focus primary attention on the effects of impulsivity, positive and negative marijuana expectancies, and marijuana self-efficacy. Adjusting for race, education, and age of first marijuana use, impulsivity has significant direct effects on both positive ($\beta = .339$, $p < .05$) and negative marijuana expectancies ($\beta = .215$, $p < .05$), and a significant inverse effect on marijuana self-efficacy ($\beta = -.171$, $p < .05$). Non-whites ($\beta = .124$, $p < .05$) and those with higher levels of educational attainment ($\beta = .150$, $p < .05$) had significantly higher negative marijuana expectancies. Individuals who reported initiating marijuana use at older ages had significantly higher levels of marijuana self-efficacy ($\beta = .149$, $p < .05$).

After controlling for other included covariates, impulsivity did not have a statistically significant direct on days using marijuana, marijuana problem severity, or marijuana dependence (Table 2). In the full mediation model, the direct effects of impulsivity on all three marijuana outcomes were constrained to 0 fit the observed data ($\chi2 = 4.95$, $df = 3$, $p = .176$). Positive marijuana expectancies had a significant direct effect ($\beta = .151$, $p < .05$) on days using marijuana but was not a significant predictor of either marijuana problem severity ($\beta = .048$, $p > .05$) or marijuana dependence ($\beta = .073$, $p > .05$). Negative marijuana expectancies had a significant inverse effect on marijuana use days ($\beta = -.304$, $p < .05$) and significant positive direct effects on both marijuana problem severity ($\beta = .540$, $p < .05$) and marijuana dependence ($\beta = .210$, $p < .05$). Marijuana self-efficacy had significant inverse effects on marijuana use days ($\beta = -.435$, $p < .05$), marijuana problem severity ($\beta = -.248$, $p < .05$), and marijuana dependence ($\beta = -.497$, $p < .05$).

Table 3 gives all 36 specific indirect effects implied by the fully-recursive structural equation model. We report only the fully standardized coefficients but note that significance levels were estimated using bias-corrected bootstrap confidence intervals for the unstandardized coefficients. Impulsivity has statistically significant indirect effects on marijuana use days via positive marijuana expectancies ($\beta = .051$, $p < .05$), negative marijuana expectancies ($\beta = -.065$, $p < .05$), and marijuana self-efficacy ($\beta = .075$, $p < .05$). Impulsivity has statistically significant specific indirect effects on marijuana problem severity via negative marijuana expectancies ($\beta = .116$, $p < .05$) and marijuana self-efficacy ($\beta = .043$, $p < .05$). Additionally, the specific indirect effects of impulsivity on marijuana dependence via both negative marijuana expectancies ($\beta = .045$, $p < .05$) and marijuana self-efficacy ($\beta = .085$, $p < .05$) are statistically significant.

Age of first marijuana use also has statistically significant indirect effects on all three outcomes via marijuana self-efficacy (Table 3). Older age of first marijuana use had a statistically significant positive direct effect on marijuana self-efficacy, which had an inverse effect on all three marijuana outcomes.

4. Discussion

This study examined associations among impulsivity, aspects of psychosocial learning, and marijuana outcomes in a test of the acquired preparedness model (APM). Unlike the only prior study to test the APM for marijuana use, which examined college students, some of whom had never used marijuana (Vangsness et al., 2005), this study recruited a sample of young adult female marijuana users from the community. Our sample is noteworthy for several reasons. First, the psychosocial learning tested in the APM involves cognitive processes that require active knowledge of the substance in question. As such, it is imperative to measure these constructs in persons who have demonstrated behavioral experience with the substance. The present sample consisted exclusively of marijuana users with, on average, over 4 years of use experience, as well as use occasions on more than half of the past 90 days. Such levels of exposure to marijuana would be sufficient to yield the psychosocial learning measured here.

Furthermore, our sample represents an understudied and vulnerable population of at-risk marijuana users, namely, young females whose rates of use have increased in the past decade (Greenfield & O’Leary, 1999; SAMHSA, 2009). The young adult age group marks the cohort with the highest proportion of marijuana users (SAMHSA, 2009), with a future trajectory that includes a number of negative consequences including substance abuse and dependence (Grant & Dawson, 1998; Lynskey et al., 2003). Indeed, given that over half of this sample met diagnostic criteria for marijuana abuse and almost 40% met criteria for dependence, one could speculate that young adult female marijuana users may already be experiencing many negative sequelae of their use, despite their low self-reported problem counts.

As expected, impulsivity was significantly and positively associated with all three marijuana use outcomes in bivariate analyses. This finding corroborates previous reports regarding the association between impulsivity and problematic substance use (Moeller & Dougherty, 2002) and expands the research evidence regarding this association for marijuana use specifically. According to the APM, this association is activated when certain types of psychosocial learning to which high-impulsives are predisposed occur. Our data are consistent with this meditational model; after adjusting for other covariates, impulsivity no longer had a significant direct effect on marijuana outcomes. Instead, multivariate tests of the APM revealed that the effect of impulsivity on marijuana outcomes was indeed fully mediated by the three measured domains of psychosocial learning. Each domain is discussed below.

In this sample, the effect of impulsivity on marijuana use frequency was mediated by positive expectancies. In the original APM, researchers posited that individuals with high trait disinhibition would be more likely to endorse beliefs that emphasize the rewarding aspects of substance use, which, in turn, would lead to greater consumption (Smith & Anderson, 2001). Our finding is thus theoretically consistent with the hypothesized APM and replicates prior empirical findings from the alcohol literature (e.g., Barnow et al., 2004; McCarthy et al., 2001b). However, our finding is at odds with those from the Vangsness et al. (2005) test of the APM for marijuana use, which did not demonstrate such mediation for positive expectancies. This discrepancy could in part be due to different operationalizations of the outcome variables in the two studies. Alternatively, it is possible that, because our sample only included persons with prior marijuana use experience, the endorsement of positive expectancies carried a different meaning than among some of the naïve individuals in the prior study.

In this sample, positive expectancies were not directly associated with either of the other two marijuana outcomes (namely, marijuana problems and marijuana dependence) and thus did not mediate their association with impulsivity. This finding is contrary to expectation, as positive expectancies have previously been shown to predict similar substance use outcomes in the past and also to mediate their association with impulsivity, at least for alcohol (e.g., Anderson et al., 2003; McCarthy et al., 2001b). It is possible that the anticipated rewards associated with alcohol use are more salient to drinkers than are the corresponding beliefs for marijuana users. Thus, perhaps, among impulsive young adult female marijuana users from the community, endorsing the pleasurable effects of marijuana use may increase frequency of use but not necessarily extend to negative consequences. If so, then perhaps marijuana users are more behaviorally influenced by other drug-related beliefs, such as those described below.

Prior tests of the APM with alcohol use have yielded somewhat conflicting results regarding the role of negative expectancies in the model, with some studies demonstrating a meditational role for negative expectancies (Anderson et al., 2005; Urbán et al., 2008) and others demonstrating no such role (Fu et al., 2007). In this sample, negative expectancies emerged as a robust mediator of the association between impulsivity and all three marijuana outcomes. A close examination of the results reveals, however, that (a) our results diverge from those of Vangsness et al. (2005), and that (b) the direction of the mediation varies by outcome variable. In the Vangsness et al. (2005) study, impulsivity had an *inverse* effect on negative expectancies, which, in turn, had an inverse effect on marijuana use. The authors' conclusion was that high-impulsives are less aware of the hazards of their drug use and thus use more frequently. Our data are consistent with an alternative explanation. In our study, impulsivity has a *direct* effect on negative expectancies, which then have an inverse indirect effect on marijuana use frequency. Our finding suggests that high-impulsives are actually aware of the negative effects of their marijuana use, which indirectly reduces the frequency of their marijuana use.

Our findings additionally indicate that impulsivity has a positive indirect effect on marijuana problems and marijuana dependence through negative expectancies. Because these indices of negative consequences were not included in the Vangsness et al. (2005) study, our findings should be considered preliminary. Nonetheless, what they appear to suggest is that, although increased negative expectances may suppress the overall frequency of marijuana use among those with high impulsivity, they experience more marijuana-related problems and a greater likelihood of a marijuana dependence diagnosis. This interpretation raises serious public health concerns regarding the hazards associated with even infrequent marijuana use among high-impulsives who are aware of its negative effects and underscores the need for intervention with this especially at-risk group.

The final component of psychosocial learning we tested in our application of the APM was refusal self-efficacy. Although self-efficacy is widely considered a critical component of Bandura's (1977) social learning theory, as well as an important mechanism in substance use recovery (Litt et al., 2008; Miller & Rollnick, 2002), to our knowledge, ours is the first study to include this variable in a direct test of the APM. In our sample, refusal self-efficacy mediated the effect of impulsivity on all three marijuana outcomes. High-impulsives tended to exhibit low self-efficacy, which, in turn, led to greater marijuana use frequency, more marijuana-related problems, and a greater likelihood of a marijuana dependence diagnosis. Our findings not only validate the APM with respect to marijuana use but also expand the breadth of psychosocial learning principles that belong in the model. As such, our study has preliminarily responded to some researchers' call to extend psychosocial learning explanations of substance use beyond expectancy theory (Dijkstra et al., 2001) and, further, identified a potential target for intervention in this high-risk marijuana using group.

One more set of results from the multivariate analysis warrants discussion. In this sample, adjusting for other covariates, age of first marijuana use had a significant direct effect on refusal self-efficacy, which then had an inverse effect on all three marijuana outcomes. These results indicate that persons who initiate marijuana use at younger ages may lack confidence in their ability to resist marijuana use in risky situations, and that this lack of confidence may result in greater frequency of marijuana use, more use-related problems, and a greater likelihood of meeting criteria for marijuana dependence. The fact that this finding emerged in a young sample suggests that, even among at-risk young marijuana users, there is a subgroup even more at risk for negative marijuana outcomes. Age of onset has previously been implicated as a predictor of future marijuana use disorders, with persons initiating use at age 14 or younger more likely to meet criteria than those initiating use at age 18 or older (SAMHSA, 2009). The present findings have identified a potential mechanism of this pathway and propose that young initiators, particularly those high on trait impulsivity, may especially benefit from coping skills training and other relapse prevention techniques in treatment.

This study has a few limitations. First, the data are cross-sectional, limiting causal conclusions. Impulsivity, the primary exogenous variable of interest in this study, reflects a personality trait that presumably develops early in life and thus likely predates the other cognitive and behavioral mediator and outcome variables examined. However, replication using prospective designs is needed. To our knowledge, the Settles et al. (2010) study on alcohol use is the only study to test the APM longitudinally. Another limitation of the study is our brief, unidimensional measure of impulsivity. Recent researchers have called for greater distinctions in definitions of impulsivity (Dougherty et al., 2009), and some studies have suggested that different dimensions of the construct may predict different aspects of substance use behavior (Smith et al., 2007). That our data nonetheless empirically validated the APM in this sample suggests that our measure, albeit brief, still captured some essence of the complex construct. However, further work is required to identify which facets of impulsivity best predict which substance use outcomes.

This study has successfully applied the acquired preparedness model (APM), a substance use explanatory theory that integrates the contribution of a disinhibited personality and psychosocial learning processes, to explain problematic marijuana use. It has done so in a sample of young adult community females, a subpopulation of marijuana users who have historically been under-researched and are considered particularly vulnerable to the negative consequences of their use. In general, our findings support previous reports of the APM but suggest that negative expectancies may play a greater role in mediating the association between impulsivity and marijuana outcomes than has been demonstrated in prior alcohol-related applications of the model. Unlike some prior work on the APM, including the one previous APM study on marijuana use, our model also evaluates multiple outcomes, including not only frequency of use but also perceived problem severity and a valid index of clinical severity, namely, marijuana dependence. Our findings also extend the existing literature on the APM by including in analyses, to our knowledge for the first time, self-efficacy as a psychosocial learning principle. In sum, the results of our study indicate that psychosocial learning processes play a critical role in explaining the well-documented link between trait impulsivity and substance use outcomes and suggest that these processes may outline potential avenues for intervention in a high-risk population of young women who use marijuana.

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References

Aarons GA, Brown SA, Stice E, Coe MT. Psychometric evaluation of the marijuana and stimulant effect expectancy questionnaires for adolescents. Addictive Behaviors 2001;26:219–236. [PubMed: 11316378]

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed.. Author; Washington, DC: 1994.

Anderson KG, Smith GT, Fischer SF. Women and acquired preparedness: Personality and learning implications for alcohol use. Journal of Studies on Alcohol 2003;534:384–392. [PubMed: 12817828]

Annis, HM.; Graham, JM. Situational confidence questionnaire (SCQ): User's guide. Addiction Research Foundation; Toronto, Canada: 1998.

Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review 1977;84:191–215. [PubMed: 847061]

Barnow S, Schultz G, Lucht M, Ulrich I, Preuss U, Freyberger H. Do alcohol expectancies and peer delinquency/substance use mediate the relationship between impulsivity and drinking behaviour in adolescence? Alcohol and Alcoholism 2004;39:213–219. [PubMed: 15082458]

Bollen KA, Stine R. Direct and indirect effects: Classical and bootstrap estimates of variability. Sociological Methodology 1990;20:115–140.

Brady KT, Randall CL. Gender differences in substance use disorders. Psychiatric Clinics of North America 1999;22:241–252. [PubMed: 10385931]

Breslin FC, Sobell LC, Sobell MB, Agrawal S. A comparison of the brief and long version of the Situational Confidence Questionnaire. Behaviour Research & Therapy 2000;38:1211–1220. [PubMed: 11104185]

Burleson JA, Kaminer Y. Self-efficacy as a predictor of treatment outcome in adolescent substance use disorders. Addictive Behaviors 2005;30:1751–1764. [PubMed: 16095844]

Cherpitel CJ. Alcohol, injury, and risk-taking behavior: Data from a national sample. Alcoholism: Clinical and Experimental Research 1993;17:762–766.

Dijkstra A, Sweeney L, Gebhardt W. Social cognitive determinants of drinking in young adults: Beyond the alcohol expectancies paradigm. Addictive Behaviors 2001;26:689–706. [PubMed: 11676379]

Dougherty DM, Mathias CW, Marsh-Richard DM, Furr RM, Nouvion SO, Dawes MA. Distinctions in behavioral impulsivity: Implications for substance abuse research. Addictive Disorders and Their Treatment 2009;8:61–73. [PubMed: 20535237]

Greenfield SF, Manwani SG, Nargiso JE. Epidemiology of substance use disorders in women. Obstetrics & Gynecology Clinics of North America 2003;30:413–416. [PubMed: 14664320]

First, MB.; Spitzer, RL.; Gibbon, M.; Williams, JB. Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P). Biometrics Research, New York State Psychiatric Institute; New York, NY: 2002.

Fu A, Ko H, Weu JY, Cherng B, Cheng C. Impulsivity and expectancy in risk for alcohol use: Comparing male and female college students in Taiwan. Addictive Behaviors 2007;32:1887–1896. [PubMed: 17287091]

Grant BF, Dawson DA. Age of onset of drug use and its association with DSM-IV drug abuse and dependence. Journal of Substance Abuse 1998;10:163–173. [PubMed: 9854701]

Greenfield SF, O'Leary G. Sex differences in marijuana use in the United States. Harvard Review of Psychiatry 1999;6:297–303. [PubMed: 10370436]

Hall W, Babor TF. Cannabis use and public health: Assessing the burden. Addiction 2000;95:485–490. [PubMed: 10829325]

Han SC, Short JL. Alcohol expectancies as a mediator of the relation between impulsivity and alcohol consumption in Asian Americans. Journal of Ethnicity in Substance Abuse 2009;8:178–200. [PubMed: 19459124]

Hayaki J, Hagerty CE, Herman DS, De Dios MA, Anderson BJ, Stein MD. Expectancies and marijuana use frequency and severity among young females. Addictive Behaviors 2010;35:995–1000. [PubMed: 20621423]

Katz EC, Fromme K, D'Amico EJ. Effects of outcome expectancies and personality on young adults' illicit drug use, heavy drinking, and risky sexual behavior. Cognitive Therapy and Research 2000;24:1–22.

LaChance H, Feldstein Ewing SW, Bryan AD, Hutchinson KE. What makes group MET work? A randomized controlled trial of college student drinkers in mandated alcohol diversion. Psychology of Addictive Behaviors 2009;23:598–612. [PubMed: 20025366]

Litt MD, Kadden RM, Kabela-Cormier E, Petry NM. Coping skills training and contingency management for marijuana dependence: Exploring mechanisms of change. Addiction 2008;103:638–648. [PubMed: 18339108]

Lynskey MT, Heath AC, Bucholz KK, Slutske WS, Maden PAF, Nelson EC, Statham DJ, Martin NG. Escalation of drug use in early onset cannabis users vs co-twin controls. Journal of the American Medical Association 2003;289:427–433. [PubMed: 12533121]

MacKinnon DP, Lockwood CM, Williams J. Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate Behavioral Research 2004;39:99–128. [PubMed: 20157642]

McCarthy DM, Kroll LS, Smith GT. Integrating disinhibition and learning risk for alcohol use. Experimental and Clinical Psychopharmacology 2001a;9:389–398. [PubMed: 11764015]

McCarthy DM, Miller TI, Smith GT, Smith JA. Disinhibition and expectancy in risk for alcohol use: Comparing black and white college samples. Journal of Studies on Alcohol 2001b;62:313–321. [PubMed: 11414341]

Miller, WR.; Rollnick, S. Motivational interviewing: Preparing people for change. 2nd ed. Guilford; New York: 2002.

Moeller FG, Dougherty DM. Impulsivity and substance abuse: What is the connection? Addictive Disorders & Their Treatment 2002;1:2–10.

Poulin C, Graham L. The association between substance use, unplanned sexual intercourse and other sexual behaviors among adolescent students. Addiction 2001;96:607–621. [PubMed: 11300964]

Ramo DE, Anderson KG, Tate SR, Brown SA. Characteristics of relapse to substance use in comorbid adolescents. Addictive Behaviors 2005;30:1811–1823. [PubMed: 16139961]

Schafer J, Brown SA. Marijuana and cocaine effect expectancies and drug use patterns. Journal of Consulting & Clinical Psychology 1991;59:558–565. [PubMed: 1918560]

Settles RF, Cyders M, Smith GT. Longitudinal validation of the acquired preparedness model of drinking risk. Psychology of Addictive Behaviors 2010;24:198–208. [PubMed: 20565146]

Smith, GT.; Anderson, KG.; Monti, PM. Adolescent risk for alcohol problems as acquired preparedness: A model and suggestions for intervention. In: Colby, M.; O'Leary, TA., editors.

Adolescents, alcohol, and substance abuse: Reaching teens through brief interventions. Guilford Press; New York, NY: 2001. p. 109-141.

Smith GT, Fischer S, Cyders MA, Annus AM, Spillane NS, McCarthy DM. On the validity and utility of discriminating among impulsivity-like traits. Assessment 2007;14:155–170. [PubMed: 17504888]

Sobell, LC.; Sobell, MB. Alcohol Timeline Followback Users' Manual. Addiction Research Foundation; Toronto, Canada: 1995.

Stephens R, Roffman R, Curtin L. Comparison of extended versus brief treatments for marijuana use. Journal of Consulting & Clinical Psychology 2000;68:898–908. [PubMed: 11068976]

Stephens R, Roffman R, Simpson E. Treating adult marijuana dependence: a test of the relapse prevention model. Journal of Consulting & Clinical Psychology 1994;62:92–99. [PubMed: 8034835]

Substance Abuse and Mental Health Services Administration. Results from the 2008 National Survey on Drug Use and Health: National Findings. U.S. Government Printing Office; Rockville, MD: 2009. NSDUH Series H-36, HHS Publication No. SMA 09-4434

Urbán R, Kökönyei G, Demetrovics Z. Alcohol outcome expectancies and drinking motives mediate the association between sensation seeking and alcohol use among adolescents. Addictive Behaviors 2008;33:1344–1352. [PubMed: 18619739]

Van Etten ML, Neumark YD, Anthony JC. Male-female differences in the earliest stages of drug involvement. Addiction 1999;94:1413–1419. [PubMed: 10615725]

VanderVeen JW, Cohen LM, Trotter DRM, Collins FL. Impulsivity and the role of smoking-related outcome expectancies among dependent college-aged cigarette smokers. Addictive Behaviors 2008;33:1006–1011. [PubMed: 18474413]

Vangsness L, Bry BH, LaBouvie EW. Impulsivity, negative expectancies, and marijuana use: A test of the acquired preparedness model. Addictive Behaviors 2005;30:1071–1076. [PubMed: 15893107]

Wallace JM Jr. Bachman JG, O'Malley PM, Schulenberg JE, Cooper SM, Johnston LD. Gender and ethnic differences in smoking, drinking and illicit drug use among American 8th, 10th, and 12th grade students, 1976-2000. Addiction 2003;98:225–234. [PubMed: 12534428]

Young SE, Corley RP, Stallings MC, Rhee SH, Crowley TJ, Hewitt JK. Substance use, abuse and dependence in adolescence: Prevalence, symptom profiles and correlates. Drug and Alcohol Dependence 2002;68:309–322. [PubMed: 12393225]

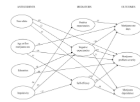

Figure 1.
Unstandardized and standardized parameter estimates for the just-identified fully recursive structural equation model. Only the statistically significant standardized path coefficients are presented. For bivariate associations, see Table 1.

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Table 1

Product-Moment Correlations, Means, and Standard Deviations (n = 332)

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Non-White (Yes)	1.00									
2. Education	−0.26*	1.00								
3. Age 1st MJ Use	0.05	0.19*	1.00							
4. Impulsivity	−0.09	−0.02	−0.06	1.00						
5. Positive MJ Expectancies	0.07	−0.10	0.04	0.33*	1.00					
6. Negative MJ Expectancies	0.07	0.12*	0.07	0.20*	0.25*	1.00				
7. MJ Self Efficacy	−0.04	0.15*	0.18*	−0.18*	−0.23*	0.01	1.00			
8. MJ Use Days	−0.08	−0.14*	−0.24*	0.12*	0.16*	−0.24*	−0.45*	1.00		
9. MJ Prob. Severity	0.15*	−0.11*	−0.12*	0.22*	0.27*	0.55*	−0.31*	0.24*	1.00	
10. MJ Dependent (Yes)	0.14	−0.12*	−0.08	0.17*	0.22*	0.20*	−0.46*	0.38*	0.57*	1.00
Mean	0.32	3.28	14.73	10.99	73.10	46.95	56.19	51.47	4.90	0.39
SD	0.47	1.25	2.18	3.74	12.42	11.46	24.96	30.56	4.68	0.49

*p < .05

Table 2

Unstandardized and Fully Standardized Parameter Estimates for Fitted SEM (n = 332)

	Positive MJ Expectancies		*Negative MJ Expectancies*		*MJ Self Efficacy*	
	b_{yx}[a] (95%CI)[c]	β_{yx}[b]	b_{yx}[a] (95%CI)	β_{yx}[b]	b_{yx}[a] (95%CI)	β_{yx}[b]
Non-White (Yes)	2.02 (−0.71;5.05)	.076	3.04* (0.21;5.87)	.124	−1.76 (−7.65;3.78)	−.033
Education	−0.86 (−1.96;0.17)	−.087	1.37* (0.30;2.45)	.150	2.12 (−0.25;4.33)	.105
Age 1st MJ Use	0.44 (−0.13;0.99)	.078	0.27 (−0.35;0.89)	.051	1.72* (0.50;2.88)	.149
Impulsivity	1.12* (0.78;1.47)	.339	0.66* (0.32;1.01)	.215	−1.16* (−1.86;−0.39)	−.171
R^2	.129		.073		.074	

	MJ Use Days		*MJ Problem Severity*		*MJ Dependence*	
Non-White (Yes)	−5.13 (−11.0;1.39)	−.085	0.88* (0.07;1.83)	.088	0.30* (0.03;0.59)	.131
Education	−0.70 (−3.13;1.63)	−.031	−0.34* (−0.71;−0.02)	−.092	−0.05 (−0.16;0.06)	−.057
Age 1st MJ Use	−2.05* (−3.30;−0.80)	−.158	−0.21* (−0.40;−0.05)	−.098	−0.01 (−0.08;0.05)	−.019
Impulsivity	0.31 (−0.57;1.16)	.041	0.07 (−0.04;0.19)	.058	0.02 (−0.02;0.06)	.071
Positive MJ Expectancies	0.34* {0.08;0.59)	.151	0.02 (−0.03;0.06)	.048	0.01 (−0.01;0.02)	.073
Negative MJ Expectancies	−0.75* (−1.04;−0.50)	−.304	0.22* (0.18;0.26)	.540	0.02* (0.01;0.03)	.210
MJ Self Efficacy	−0.49* (−0.60;−0.35)	−.435	−0.05* (−0.06;−0.03)	−.248	−0.02* (−0.03;−0.02)	−.497
R^2	.392		.433		.390	

* 95% CI Estimate for the unstandardized parameter estimate excludes 0.

[a] Unstandardized parameter estimate.

[b] Fully standardized parameter estimate.

[c] 95% Confidence intervals estimated by bias-corrected bootstrap with 5000 resamplings.

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Table 3

Standardized Specific Indirect Effects of Exogenous Variables on Marijuana (MJ) Outcomes Mediated by Positive Marijuana Effects Expectancies, Negative Marijuana Effects Expectancies, and Marijuana Self Efficacy

	Exogenous Variable			
Specific Indirect Effect	***Ethnicity***	***Education***	***Age 1st MJ Use***	***Impulsivity***
on MJ Use Days				
via Positive MJ Expectancies	.012	−.013	.012	.051*
via Negative MJ Expectancies	−.038	−.046*	−.015	−.065*
via MJ Self Efficacy	.014	−.046	−.065*	.075*
on MJ Problem Severity				
via Positive MJ Expectancies	.004	−.004	.004	.016
via Negative MJ Expectancies	.067*	.081*	.027	.116*
via MJ Self Efficacy	.008	−.026	−.037*	.043*
on MJ Dependence				
via Positive MJ Expectancies	.006	−.006	.006	.025
via Negative MJ Expectancies	.026	.031	.011	.045*
via MJ Self Efficacy	.016	−.052	−.074*	.085*

* $p < .05$. Specific indirect effects were considered statistically significant if 0 was not included in the 95%CI estimated by bias-corrected bootstrap with 5000 random draws.