Cannabis Use Expectancies Mediate the Relation Between Depressive Symptoms and Cannabis Use Among Cannabis-Dependent Veterans

Samantha G. Farris, MA, Michael J. Zvolensky, PhD, Matthew Tyler Boden, PhD, and Marcel O. Bonn-Miller, PhD

Objectives: The current study examined the cross-sectional associations between depressive symptoms and cannabis use, and the mediating role of positive and negative expectancies of cannabis use.

Methods: Participants (n = 100) were cannabis-dependent veterans recruited as part of a larger self-guided cannabis quit study. Baseline (prequit) data were used. Depressive symptoms were assessed using the General Depression subscale of the Inventory of Depression and Anxiety Symptoms (IDAS), and cannabis use expectancies were assessed using the Marijuana Effect Expectancies Questionnaire. Quantity of cannabis use in the past 90 days was assessed with the Timeline Follow-Back.

Results: A parallel multiple mediation path analysis was conducted to simultaneously examine the effects of positive and negative expectancies as mediators of the relation between IDAS-Depression and prequit cannabis use. Results indicated that depressive symptoms were indirectly related to cannabis use through positive, but not negative, expectancies. This effect was unique to IDAS-Dysphoria symptoms.

Conclusions: Depressive symptoms, particularly cognitive-affective symptom features, may be important to consider in better understanding positive cannabis effect expectancies among veterans in regard to cannabis use.

Key Words: cannabis, depression, expectancies, marijuana, veterans

(*J Addict Med* 2014;8: 130–136)

Cannabis use and its disorders are a highly prevalent problem among military veterans (Ritter et al., 1985; Goldman et al., 2010; Bonn-Miller et al., 2012). In addition, many veterans with cannabis use disorders have co-occurring psychological disorders (approximately 71%; eg, depression and posttraumatic stress disorder; Bonn-Miller et al., 2012). Yet, research on the role of psychological disorders and related symptoms among veterans in terms of cannabis use is highly limited.

Depressive symptoms, in particular, represent an important area of study among this population because of the high prevalence rate of mood disorders and suicide among veterans (Kang and Bullman, 2008; McCarthy et al., 2009). In nonveteran samples, cannabis dependence has been found to be related to an increased risk of major depressive episodes and disorder (Agosti et al., 2002; Chen et al., 2002). In addition, cannabis dependence is significantly predictive of the later development of certain types of cognitive-affective depressive symptoms (eg, anhedonia and suicidal ideation; Bovasso, 2001). Among veterans, substance use disorders are associated with increased functional impairment, medical problems, homelessness, and suicide (Edens et al., 2011; Nazarian et al., 2012). Moreover, mood disorders and other substance use (eg, alcohol and tobacco) have been found to be significantly related to an increased risk for cannabis use (Goldman et al., 2010), and substance use. These data collectively highlight the public health relevance of addressing substance use and mental health among veteran populations. As a result, research has attempted to further explicate the nature of the association between depressive symptoms and cannabis use.

One area of mechanism research has explored the role of expectancies about the anticipated benefits/harms of substance use (ie, outcome expectancies; Brown et al., 1980; Schafer and Brown, 1991) and how such expectancies relate to psychological symptoms and actual substance use. Expectancies are typically described as 2 general differentially valenced factors, including positive expectancies (ie, beliefs about the

From the Department of Psychology (SGF, MJZ), University of Houston, Houston, TX; Department of Behavioral Sciences (MJZ), University of Texas MD Anderson Cancer Center, Houston, TX; Center for Health Care Evaluation (MTB, MOBM), VA Palo Alto Health Care System, Palo Alto, CA; Center of Excellence in Substance Abuse Treatment and Education (MOBM), Philadelphia VAMC National Center for PTSD, Philadelphia, PA; and Department of Psychiatry (MOBM), University of Pennsylvania Perelman School of Medicine, Philadelphia.

Received for publication May 07, 2013; accepted November 04, 2013.

Supported by a Veterans Administration Clinical Science Research and Development Career Development Award–2, awarded to Dr Marcel O. Bonn-Miller. Ms Farris was supported by a cancer prevention fellowship through the University of Texas MD Anderson Cancer Center, funded by the National Cancer Institute grant (R25T-CA057730).

The funding source had no role other than financial support. The content does not necessarily represent the official views of the Veterans Affairs, National Cancer Institute, or the National Institutes of Health.

The authors declare no conflicts of interest.

Send correspondence and reprint requests to Marcel O. Bonn-Miller, PhD, 795 Willow Rd (152-MPD), Menlo Park, CA 94025. E-mail: Marcel.Bonn-Miller@va.gov.

ISSN: 1932-0620/14/0802-0130

DOI: 10.1097/ADM.0000000000000010

pleasurable or desirable effects of substance use) and negative expectancies (ie, beliefs about unwanted effects of substance use; Jones et al., 2001). These different types of expectancies seem to differentially influence drug use behavior (Jones et al., 2001). Indeed, there is a voluminous literature documenting the theoretically and clinically significant role of expectancies among substance-using nonveteran samples (see reviews by Jones et al., 2001; Leventhal and Schmitz, 2006). For example, positive drug outcome expectancies (eg, relaxation and mood enhancement) are often associated with greater levels of substance use and dependence (eg, Copeland et al., 1995; Kilbey et al., 1998). Other research has shown that drug outcome expectancies for mood regulation are associated with the tendency to experience greater negative affect (eg, Cohen et al., 2002). In contrast, negative substance use expectancies are associated with motivation to decrease or restrict substance use among current users (Jones et al., 2001).

Although far less is known about the role of *cannabis* expectancies in general, and among veterans in particular, available work suggests that positive cannabis use expectancies (ie, social/sexual facilitation, perceptual/cognitive enhancement, tension reduction/relaxation expectancies, and craving/physical effects) are related to cannabis use and greater patterns of use among nonveteran samples (Schafer and Brown, 1991; Aarons et al., 2001; Simons and Arens, 2007; Hayaki et al., 2010). In contrast, negative outcome expectancies (ie, general negative effects and cognitive/behavioral impairment) are associated with nonuse, lower rates of cannabis use, and cannabis quit success among nonveterans (Schafer and Brown, 1991; Aarons et al., 2001). Other work has found that negative expectancies of cannabis use may mediate the relation between certain psychological conditions (eg, social anxiety disorder) and severity of cannabis use problems among nonveteran samples (Buckner and Schmidt, 2008).

The literature on substance use expectancies among veterans is significantly smaller in scope and thus far largely focused on alcohol or tobacco use expectancies (eg, Norman et al., 2008; Carmody et al., 2012). The existing research suggests that among veterans, positive expectancies (eg, expecting relaxation or cravings), but not negative expectancies, are related to current use (Galen and Henderson, 1999) and predictive of relapse among cannabis-dependent veterans attempting to quit (Boden et al., 2013).

It is possible that the relations between depressive symptoms and cannabis use are explained by certain expectancies or beliefs held by veterans—specifically, that cannabis use will result in positive outcomes. First, acute cannabis use produces relaxation, happiness, and other positive affect states, particularly among regular users (Green et al., 2003). Thus, a veteran prone to experience cognitive-affective depressive symptoms (eg, dysphoria, anhedonia, and suicidal ideation) may be more apt to use cannabis in greater amounts/frequency to achieve these positive affective states, as these states are typically limited in frequency and duration among individuals with depression (American Psychiatric Association, 2000). Second, acute cannabis use has been shown to decrease neurovegatitive depressive symptoms among frequent users (eg, disrupted sleep and appetite stimulation; Iversen, 2003; Chagas et al., 2013). In contrast, depressive symptoms are apt to be less strongly associated with negative cannabis expectancies, as negative affective states and personality features (eg, neuroticism) have been documented to inhibit negative expectancies (Leventhal and Schmitz, 2006). Importantly, depressive symptoms are heterogeneous in nature and typically fall into general cognitive-affective symptoms (eg, depressed affect, crying, anhedonia, and negative attitudes toward self), somatic/neurovegatitive symptoms (eg, appetite loss, sleep problems, gastrointestinal problems, restlessness, and irritability), and (a lack of) positive affective symptoms (eg, feeling happy, enjoying things, and positive outlook on future; see meta-analyses by Shafer, 2006). Although the heterogeneous nature of depressive symptoms has been widely discussed within the mood disorders literature, it is presently unclear how different depressive symptom dimensions may impact cannabis use or expectancies for use.

Together, the present cross-sectional study evaluated the mediating role of cannabis expectancies (positive and negative) in regard to depressive symptoms and quantity of cannabis use among a sample of cannabis-dependent veterans. On the basis of existing empirical literature (Galen and Henderson, 1999; Simons and Arens, 2007; Clark et al., 2011), it was hypothesized that higher levels of general depressive symptoms would be related to greater quantity of cannabis use. This relation was expected to be explained by the indirect effects of positive cannabis use expectancies. It was hypothesized that any observed effects would be evident after adjusting for theoretically-relevant variables known to co-occur with cannabis use and depression among veterans samples, including tobacco and alcohol use and psychological disorders. As an exploratory aim, distinct depressive symptoms (ie, dysphoria, lassitude, insomnia, suicidality, appetite loss/gain, ill-temper/irritability, and well-being) were examined for their unique association with cannabis expectancies in predicting cannabis use. Given the exploratory nature of this second aim, no specific hypothesis was made.

METHODS

Participants

Participants (n = 100; 95.0% male; M_{age} = 50.8, SD = 10.02 years) were cannabis-dependent US military veterans participating in a cannabis self-quit study, recruited through flyers posted throughout the Palo Alto Veterans Affairs Medical Center. A total of 105 participants were recruited as part of the parent study; however, for the purposes of the current project, 5 cases were removed from analyses because of missing data on the key variables. Veterans were from 3 branches of the military (ie, Army, Navy, and Marines). Most veterans indicated that they served during the 1960s to 1990s in either wartime or peacetime (70.0%) or within the past decade in Operation Enduring Freedom or Operation Iraqi Freedom (8.0%); data were unavailable for the remaining 22.0% of the sample. The sample was ethnically diverse and identified as white (37.0%), African American (34.0%), Hispanic (15.0%), Asian (1.0%), other (12.0%), and not reported (1.0%). Participants primarily reported being divorced/separated (43.0%), never married (24.0%), or married/cohabitating (23.0%), and most participants completed part or all of a 2- or 4-year college (71.0%).

Most veterans reported daily cannabis use (72.0%). Daily alcohol and tobacco use were reported by 68.0% and 59.0% of the sample, respectively. Rates of comorbid current (past month) Axis I psychopathology were high (66.0%). Thirty-five percent of the sample met diagnostic criteria for major depressive disorder or dysthymia.

Measures

Structured Clinical Interview for DSM-IV Disorders (SCID-I; First et al., 1996)

The Structured Clinical Interview for *DSM-IV* Disorders (SCID-I) is a clinician-administered semistructured diagnostic assessment of Axis I psychopathology on the basis of the *Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition, Text Revision)* (*DSM-IV-TR*) diagnostic guidelines. In the present study, diagnostic criteria for cannabis dependence were consistent with the definition set forth in the *DSM-IV-TR* (American Psychiatric Association, 2000), with the addition of withdrawal, as proposed for *DSM-5*. The SCID-I has good psychometric properties, including validity and interrater reliability (eg, Lobbestael et al., 2011). In the current study, diagnostic assessments were audio-recorded and reviewed by the study principal investigator (last author) for reliability and diagnostic accuracy.

*Inventory of Depression and Anxiety Symptoms (*Watson et al., 2007)

The Inventory of Depression and Anxiety Symptoms (IDAS) is a 64-item self-report measure of symptoms of major depression and anxiety disorders. Respondents are asked to rate the degree to which they have experienced symptoms in the past 2 weeks, scored on a 5-point Likert-type scale (1 = "not at all" to 5 = "extremely"). This measure yields a global General Depression score (20 items), which was used as the primary predictor in the present study. Post hoc analyses on the specific indices of depressive symptoms were conducted using 8 specific depression-relevant subscales of the IDAS, including Dysphoria (10 items), Lassitude (6 items), Insomnia (6 items), Suicidality (6 items), Appetite Gain (3 items), Appetite Loss (3 items), Ill-Temper (5 Items), and Well-Being (8 items). The IDAS has strong psychometric properties, including internal consistency and test-retest reliability, and convergent and discriminant validity (Watson et al., 2007). Internal consistency for the General Depression subscale in the current study was excellent ($\alpha = 0.93$) and good to excellent for all depression-relevant facet scales (αs = 0.70-0.95).

Marijuana Effect Expectancies Questionnaire (Schafer and Brown, 1991)

The Marijuana Effect Expectancies Questionnaire (MEEQ) is a 78-item self-report questionnaire that assesses current thoughts, feelings, and beliefs about cannabis, rated on a scale from 1 ("disagree strongly") to 5 ("agree strongly"). The MEEQ yields 6 statistically derived factors (Schafer and Brown, 1991), which can be used to represent Positive and Negative expectancy scales (Schafer and Brown, 1991; Buckner and Schmidt, 2008). We calculated the positive expectancies scale from the mean of items from 4 factors that were highly associated in this sample ($r(100) = 0.45$-0.72; $P < 0.001$): relaxation/tension reduction (eg, "I get a sense of relaxation from smoking marijuana"), social/sexual facilitation (eg, "I am more sociable when I smoke marijuana"), perceptual/cognitive enhancement (eg, "I become more creative or imaginative on marijuana"), and craving/physical effects (eg, "Marijuana makes me hungry"). We calculated the negative expectancies scale from the mean of the remaining 2 factors, which were highly associated ($r(100) = 0.66$; $P < 0.001$): cognitive/behavioral impairment (eg, "Marijuana slows thinking and actions") and global negative effects (eg, "Marijuana can make my feelings from happy to sad"). This measure has strong documented psychometric properties, including good test-retest reliability, and convergent and divergent validity (Schafer and Brown, 1991). In the current study, internal consistency was good to very good across all MEEQ subscales (αs = 0.76-0.90).

Timeline Follow-Back Interview (Sobell and Sobell, 1992)

The Timeline Follow-Back is a calendar-based assessment of substance use, in which data are collected using clinician-guided retrospective recall. Mean use per day of cannabis, tobacco (the number of cigarettes), and alcohol (the number of standard drinks) was assessed for the past 90 days (before quit attempt). Regarding cannabis use, respondents were asked to estimate their typical quantity of cannabis use per day by using a visual scale that consisted of 8 images of cannabis, incrementally increasing in size, with corresponding numbers from 1 (smallest) to 8 (largest; see Bonn-Miller and Zvolensky, 2009). Participants circled the image (and the corresponding number) that best represented the amount of cannabis that they used per day. This visual scale was used to facilitate standardization of reporting, given that concentrations of cannabis can vary depending on individual use and method of consumption. The Timeline Follow-Back has been found to have very strong psychometric properties up to 90 days, including excellent interrater reliability, test-retest reliability, and strong convergent validity based on collateral interviews (Carey, 1997; Norberg et al., 2012).

Procedure

Data were collected as part of a larger cannabis quit study (see Boden et al., 2013; Heinz et al., 2013), and only baseline (prequit) data were used in this investigation. Eligible participants were veterans, met criteria for a cannabis dependence disorder, reported motivation to quit of at least 5 on a 10-point rating scale, and expressed interest in making a serious cannabis self-quit attempt. Exclusion criteria included (1) a recent decrease in daily cannabis use (by $\geq$25%) in the past month, (2) pregnancy or current breastfeeding, (3) current suicidal ideation, and (4) limited mental capacity and/or inability to provide informed written consent.

The baseline appointment was scheduled 1 day before the day veterans were willing to undergo a serious self-guided quit attempt. A trained research assistant administered the SCID-I to determine a cannabis dependence diagnosis and other psychopathology and completed the Timeline Follow-Back. The IDAS and the MEEQ were completed as part of a

larger battery of self-report assessments, and participants were compensated $75 at the end of the appointment. All participants provided signed informed consent before participation in any study activities. This study was approved by the institutional review boards at the Veterans Affairs Palo Alto Health Care System and Stanford University.

Data Analytic Strategy

Analyses were conducted in PASW Statistics 21.0 (SPSS Inc, Chicago, Illinois). First, zero-order correlations among predictor, proposed mediator, and criterion variables were examined. Next, a parallel multiple mediator model was conducted to examine MEEQ-Positive and MEEQ-Negative scales as mediators of the relation between IDAS-General Depression subscale and prequit cannabis use (please see Fig. 1). This model allows for simultaneous examination of 2 independent, yet correlated, mediators. Prequit quantity of tobacco and alcohol use (mean use per day) and the number of comorbid Axis I disorders were included as covariates in the model. Analyses were conducted using PROCESS, a conditional process-modeling program that uses an ordinary least squares-based path analytical framework to test for both direct and indirect effects (Hayes, 2013). All indirect effects were subjected to follow-up bootstrap analyses with 10,000 samples and a 95% confidence interval (CI) estimate (as recommended by Preacher and Hayes, 2004, 2008; Hayes, 2009). Next, post hoc analyses were conducted to examine the effects of specific depressive symptoms in the mediation model. Analyses were conducted using MEDIATE (Hayes and Preacher, 2013), a modeling program that allows for testing of the direct, indirect, and total effects independent variables (x_i) on an outcome variable (y) through a proposed mediator variable (M) or set of mediator variables (M_i). All 8 IDAS subscales (with nonoverlapping items) were entered as predictors in this model ($x_{1\ldots8}$). As in the previous model, covariates were included (alcohol and tobacco use and Axis I disorders) and inferences for indirect effects were based on a 95% bootstrap CI.

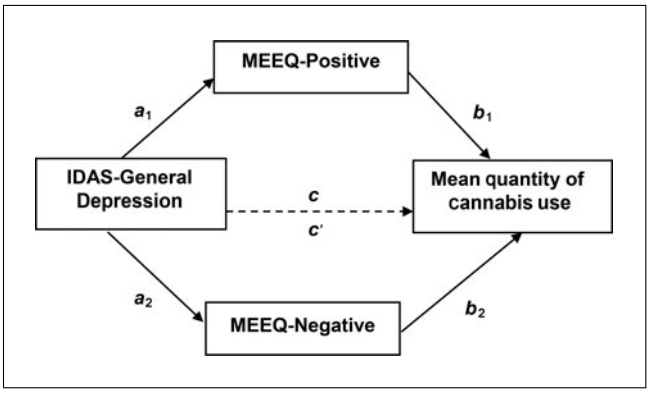

FIGURE 1. Conceptual model of parallel multiple mediation analysis. a_1 and a_2 = specific indirect effects of X on M_1 and M_2; b_1 and b_2 = specific indirect effects of M_1 and M_2 on Y; c = total effect of X on Y, independent of M_1 and M_2; c' = direct effect of X on Y, controlling for M_1 and M_2; $a_1 \times b_1$ and $a_2 \times b_2$ = relative indirect effects of M_1 and M_2.

RESULTS

Descriptive Results

Descriptive and correlational results are presented in Table 1. The IDAS-Depression and the MEEQ-Positive were related to greater quantity of cannabis use. Alcohol and tobacco use were significantly interrelated. The number of Axis I diagnoses was related to higher IDAS-Depressive scores and alcohol use. The MEEQ-Positive and MEEQ-Negative scales were significantly intercorrelated.

Results of the total effects model (path c) reveled a significant effect of IDAS-Depressive scores on quantity of cannabis use ($b = 0.032$; SE = 0.015; $t = 2.094$; $P = 0.039$), with greater depressive scores predicting greater quantity of cannabis use. The test of the relative indirect effect of IDAS-Depression on MEEQ-Positive ($a_1 \times b_1$) was significant ($b = 0.007$; 95% CI, 0.001 to 0.020). Thus, the association between depressive symptoms and cannabis use occurred indirectly through holding stronger positive expectancies about the effect of cannabis use. However, the relative indirect effect of IDAS-Depression on MEEQ-Negative ($a_2 \times b_2$) was not significant ($b = 0.000$; 95% CI, -0.004 to 0.006). Please see Table 2 for full regression results.*

A post hoc mediation analysis was conducted to further explore the association between the mediator (MEEQ-Positive) and the 8 different depression symptom dimensions per the IDAS on cannabis use (Table 3). In the total effects model, IDAS-Dysphoria was the only significant predictor of mean cannabis use ($b = 0.112$; SE = 0.055; $t = 2.014$; $P = 0.047$), such that higher self-reported dysphoria symptoms were related to greater average quantity of cannabis use. The follow-up bootstrap estimates of the relative indirect effects revealed that IDAS-Dysphoria was significantly, indirectly predicting cannabis use through MEEQ-Positive ($b = 0.025$; 95% CI, 0.001 to 0.068), with stronger positive expectancies accounting for this effect.

DISCUSSION

As expected, depressive symptoms were indirectly associated with quantity of cannabis use through positive, but not negative, cannabis use expectancy effects. These effects were evident after accounting for concurrent alcohol and tobacco use and Axis I diagnoses. The results suggest that veterans reporting greater depressive-related symptoms maintain stronger beliefs (concurrently) that cannabis will assist in behavioral activation and life engagement or increase positive affect, which in turn predict daily cannabis use. This finding can be taken in concert with nonveteran work, which has found positive drug expectancies moderate the effect of depressive symptoms on cannabis use, such that the combination of high levels of depression symptoms with

*The same model was tested with a categorical depression predictor variable (coded as 0 = no mood disorder; 1 = mood disorder present). In this model, cannabis expectancies (either positive or negative) did not mediate the relations between depression status and quantity of cannabis use at baseline, which might be explained by the finding that depression has increased predictive validity when measured dimensionally relative to categorically (Prisciandaro and Roberts, 2009).

TABLE 1. Descriptive Statistics and Correlations for Predictor, Mediator, and Criterion Variables

Variable	Mean (SD)	1	2	3	4	5	6	7
1. Cannabis quantity	5.9 (2.07)	—	0.15	0.06	0.11	0.21*	0.10	0.24*
2. Cigarettes use	6.3 (8.04)		—	0.26†	0.13	−0.05	0.09	0.05
3. Alcohol use	2.3 (4.93)			—	0.33†	0.18	0.22*	0.16
4. No. Axis I Dx	1.3 (1.25)				—	0.58†	0.11	0.18
5. IDAS-Depression	48.5 (16.71)					—	0.14	0.31†
6. MEEQ-Negative	2.7 (0.80)						—	0.33†
7. MEEQ-Positive	3.4 (0.63)							—

Columns 1 to 7 correspond to the variables numbers in the left column.

*$P < 0.05$; †$P < 0.01$.

Alcohol use = mean alcohol use (standard drink) per day for 90 days before quit-day assessed by the Timeline Follow-Back (Sobell and Sobell, 1992); cannabis quantity = mean quantity of cannabis use per day (rated on the 8-point visual scale) for 90 days before quit-day assessed by the Timeline Follow-Back (Sobell and Sobell, 1992); cigarette use = mean cigarette use per day for 90 days before quit-day assessed by the Timeline Follow-Back (Sobell and Sobell, 1992); IDAS-Depression = Inventory of Depression and Anxiety Symptoms–General Depression (Watson et al, 2007); MEEQ = Marijuana Effect Expectancies Questionnaire (Schafer and Brown, 1991); no. Axis I Dx = number of current (past month) comorbid Axis I diagnoses assessed by the Structured Clinical Interview for *DSM-IV* Disorders (First et al, 1996).

TABLE 2. Regression Results for the Mediation of the Effect of IDAS-Depression on Cannabis Use by MEEQ-Positive and MEEQ-Negative

Model	*b*	SE	*P*	CI (Lower Bound)	CI (Upper Bound)
Model without mediators					
Intercept	4.032	0.689	<0.001	2.664	5.399
DEP → USE (c)	0.032	0.015	0.039	0.002	0.062
$R^2_{Y,X}$	0.073		0.122		
Model with mediators					
Intercept_1	2.835	0.206	<0.001	2.427	3.243
DEP → POS (a_1)	0.012	0.005	0.009	0.003	0.021
Intercept_2	2.295	0.269	<0.001	1.760	2.839
DEP → POS (a_2)	0.006	0.006	0.308	−0.006	0.018
POS → USE (b_1)	0.600	0.357	0.097	−0.110	1.309
POS → USE (b_2)	0.024	0.273	0.931	−0.518	0.566
DEP → USE (c′)	0.025	0.016	0.123	−0.007	0.056
Indirect effect ($a_1 \times b_1$)	0.007	0.005		0.001	0.020
Indirect effect ($a_2 \times b_2$)	0.000	0.002		−0.004	0.006
$R^2_{M1,X}$	0.110		0.024		
$R^2_{M2,X}$	0.059		0.209		
$R^2_{Y,M12X}$	0.104		0.109		

Regression paths *a*, *b*, *c*, and *c*′ are illustrated in Figure 1. $R^2_{Y,X}$ is the proportion of variance in *Y* explained by *X*, $R^2_{M,X}$ is the proportion of variance in *M* explained by *X*, and $R^2_{Y,M12X}$ is the proportion of variance in *Y* explained by *X* and *M*. The 95% CI for $a \times b$ is obtained by bootstraping with 10,000 resamples. The CIs for R^2 indices are obtained analytically. DEP (IDAS-Depression) is the independent variable (*X*), POS (MEEQ-Positive; M_1) and NEG (MEEQ-Negative; M_2) are the mediators, and USE (quantity of cannabis use) is the outcome (*Y*).

b, coefficient; CI, confidence interval; MEEQ, Marijuana Effect Expectancies Questionnaire; SE, standard error estimate; →, affects.

TABLE 3. Tests of the Indirect Effects of IDAS Subscales on Cannabis Use Through MEEQ-Positive

Predictor	*b*	CI (Lower Bound)	CI (Upper Bound)
IDAS subscale			
Dysphoria	0.026	0.002	0.069
Lassitude	−0.001	−0.041	0.024
Insomnia	−0.007	−0.037	0.004
Suicide	0.012	−0.006	0.061
Appetite Gain	−0.006	−0.051	0.023
Appetite Loss	−0.009	−0.055	0.015
Ill-Temper	−0.028	−0.077	0.001
Well-Being	0.001	−0.010	0.018

b, coefficient; CI, confidence interval; MEEQ, Marijuana Effect Expectancies Questionnaire.

high positive drug expectancies are more apt to be associated with a greater likelihood of future cannabis use (Clark et al., 2011). In addition, this finding is consistent with theoretical models suggesting that trait anhedonia/dysphoria is related to seeking pharmacological rewards for pleasure (ie, to stimulate an under-responsive system; Harvey et al., 2007). Such an observation is further supported by increasing specificity and discriminant validity as a result of the nonsignificant effect of positive affect on cannabis use, as measured by the IDAS-Well-Being subscale. Overall, the present findings suggest that positive cannabis use expectancies are relevant to better understanding the nature of the interplay between depressive symptoms and cannabis use among veterans.

Analyses on the depressive symptom dimensions revealed that the observed mediation effect seems to be accounted for by dysphoria symptoms. This finding suggests that cognitive-affective depressive symptoms (eg, feeling inadequate, discouraged, and blaming self) among veterans, in particular, may be especially important to consider in relation to cannabis use. These findings are generally in accord with theories on drug use and emotion (see Kassel et al., 2010), which suggest that (1) beliefs about the effects of a particular drug are more cognitively accessible when one is exposed to cues (eg, negative mood states) similar to those present when

expectancies were initially formed (ie, encoding specificity), and that (2) one is likely to use that drug when exposed to cues previously associated with drug use (ie, situational specificity). In effect, a negative mood state may trigger activation of affective-relevant cannabis outcome expectancies (eg, "I have a happy, good feeling when I smoke marijuana") and in turn, influence how those expectancies are cognitively processed (Kassel et al., 2010). Moreover, these results are, again, in line with models of hedonic capacity (Harvey et al., 2007), and noncannabis research documenting cognitive-affective aspects of depression often maintain greater explanatory value than neurovegatitive depressive symptom in terms of substance use motivation/expectancies (Leventhal et al., 2011).

Notably, depressive and cannabis withdrawal symptoms highly overlap. Cannabis withdrawal symptoms tend to be primarily emotional or behavioral in nature (eg, irritability, nervousness, restlessness, and depressed mood; Budney et al., 2004) and are predictive of reinitiation of cannabis use (eg, rapid relapse; Cornelius et al., 2008). In the present study, most participants (92.0%) reported cannabis use on the day before the baseline assessment. Of the remaining 8%, all but 1 participant reported cannabis use in the past 3 days. On the basis of the overall recency of cannabis use, it is possible that the affective or neurovegatitive symptoms reported are related to mood disturbance (ie, depressive symptoms) as opposed to withdrawal symptoms. Yet, the present methodology cannot fully and unambiguously disentangle cannabis withdrawal from depressive symptoms and other negative mood. Therefore, future research would benefit by using experimental methodology to explore the unique and overlapping roles of cannabis withdrawal and depressive symptoms in terms of cannabis use behavior.

There are several limitations of the current study. First, the present study relied on cross-sectional methodological design. Thus, it is unclear whether greater depressive symptoms are causally related to increases in positive cannabis use expectancies, or related to cannabis use. In addition, mediator models are causal models and carry with them the usual criteria for making causal claims. Because of the cross-sectional nature of the data in the current sample, the mediation test was solely based on a theoretical framework, not temporal sequencing. Future research could examine the role of depressive symptoms over time or via experimental research designs to better isolate patterning of effects with cannabis expectancies and actual use. Second, whereas the present study focused on depressive symptoms, there are other negative affect symptoms (eg, traumatic stress symptoms, panic attacks, or social anxiety symptoms) that may warrant further consideration. Moreover, depressive symptoms were only assessed in reference to the past 2 weeks in the present study. Thus, this index of depressive symptoms did not necessarily capture trait levels of depression per se. Third, the sample primarily consisted of older male veterans. It is therefore unknown how the current findings would generalize to female veterans or those who have served primarily in a more recent era (eg, Operation Enduring Freedom/Operation Iraqi Freedom). Fourth, it is unknown to what extent the veterans in the current sample were exposed to combat-related experiences. Past work has found that combat exposure can intensify both depressive symptoms and substance use (Skidmore and Roy, 2011). Thus, combat-related experiences theoretically could impact depressive symptoms and expectancies for cannabis use differently than noncombat experiences. Fifth, self-report measures were used as the primary assessment methodology. The use of self-report methods does not fully protect against reporting errors and may be influenced by shared-method variance. Thus, future studies could build upon the present work by using more comprehensive multimethod protocols. Last, veterans were recruited as part of a self-guided quit study for monetary reward. As such, this sample may not be representative of veterans not seeking to change their cannabis use or may involve a self-selection bias.

An important consideration when working with military populations is that illicit substance and psychological distress may be minimized or underreported, as veterans often cite stigma-related fears in regard to symptom reporting (Skidmore and Roy, 2011). That is, military personnel may not want to acknowledge using cannabis or depressive symptoms because of perceived or real negative consequences (eg, loss of benefits and social criticism; Skidmore and Roy, 2011). The present results underscore the importance of examining cannabis use and depressive symptoms in veterans, given the high base rates of affective psychopathology and symptoms documented in the current sample. In addition, the present findings suggest that dysphoria symptoms may be particularly related to cannabis use, as a result of specific beliefs veterans hold about the positive outcome effects of cannabis. Overall, the findings suggest that there is potential utility in measuring and clinically addressing depressive symptoms among veterans in the context of cannabis treatment through which positive expectancies about cannabis use could be evaluated and challenged, such as through the use of cognitive restructuring techniques (Kassel et al., 2010).

REFERENCES

Aarons GA, Brown SA, Stice E, et al. Psychometric evaluation of the Marijuana and Stimulant Effect Expectancy Questionnaires for adolescents. *Addict Behav* 2001;26:219–236.

Agosti V, Nunes E, Levin F. Rates of psychiatric comorbidity among U.S. residents with lifetime cannabis dependence. *Am J Drug Alcohol Abuse* 2002;28:643–652.

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington, DC: American Psychiatric Association, 2000.

Boden MT, McKay JR, Long WR, et al. The effects of cannabis use expectancies on self-initiated cannabis cessation. *Addiction*. 2013;108:1649–1657.

Bonn-Miller MO, Harris AS, Trafton JA. Prevalence of cannabis use disorder diagnoses among veterans in 2002, 2008, and 2009. *Psychol Serv* 2012;9:404–416.

Bonn-Miller MO, Zvolensky MJ. An evaluation of the nature of marijuana use and its motives among young adult active users. *Am J Addict* 2009;18:409–416.

Bovasso GB. Cannabis abuse as a risk factor for depressive symptoms. *Am J Psychiatry* 2001;158:2033–2037.

Brown SA, Goldman MS, Inn A, et al. Expectations of reinforcement from alcohol: their domain and relation to drinking patterns. *J Consult Clin Psychol* 1980;48:419–426.

Buckner JD, Schmidt NS. Marijuana effect expectancies: relations to social anxiety and marijuana use problems. *Addict Behav* 2008;33:1477–1483.

Budney AJ, Hughes JR, Moore BA, et al. Review of the validity and significance of cannabis withdrawal syndrome. *Am J Psychiatry* 2004;161:1967–1977.

Carey KB. Reliability and validity of the time-line follow-back interview among psychiatric outpatients: a preliminary report. *Psychol Addict Behav* 1997;11:26–33.

Carmody T, Delucchi K, Hall S, et al. Expectancies regarding the interaction between smoking and substance use in alcohol-dependent smokers in early recovery. *Psychol Addict Behav* 2012;26:358–363.

Chagas M, Crippa J, Andersen M, et al. Effects of acute systemic administration of cannabidiol on sleep-wake cycle in rats. *J Psychopharmacol* 2013;27(3):312–316.

Chen C, Wagner FA, Anthony JC. Marijuana use and the risk of major depressive episode: epidemiological evidence from the United States National Comorbidity Survey. *Soc Psychiatry Psychiatr Epidemiol* 2002;37:199–206.

Clark H, Ringwalt C, Shamblen S. Predicting adolescent substance use: the effects of depressed mood and positive expectancies. *Addict Behav* 2011;36:488–493.

Cohen L, McCarthy D, Brown S, et al. Negative affect combines with smoking outcome expectancies to predict smoking behavior over time. *Psychol Addict Behav* 2002;16(2):91–97.

Copeland AL, Brandon TH, Quinn EP. The Smoking Consequences Questionnaire–Adult: measurement of smoking outcome expectancies of experienced smokers. *Psychol Assess* 1995;7:484–494.

Cornelius JR, Chung T, Martin C, et al. Cannabis withdrawal is common among treatment-seeking adolescents with cannabis dependence and major depression, and is associated with rapid relapse to dependence. *Addict Behav* 2008;33:1500–1505.

Edens EL, Kasprow W, Tsai J, et al. Association of substance use and VA service connected disability benefits with risk of homelessness among veterans. *Am J Addict* 2011;20:412–419.

First MB, Spitzer RL, Gibbon M, et al. Structured Clinical Interview for *DSM-IV* Axis I Disorders (SCID-I). Washington, DC: American Psychiatric Press, 1996.

Galen LW, Henderson MJ. Validation of cocaine and marijuana effect expectancies in a treatment setting. *Addict Behav* 1999;24:719–724.

Goldman M, Suh JJ, Lynch KG, et al. Identifying risk factors for marijuana use among Veterans Affairs patients. *J Addict Med* 2010;4:47–51.

Green B, Kavanagh D, Young R. Being stoned: a review of self-reported cannabis effects. *Drug Alcohol Rev* 2003;22:453–460.

Harvey P, Pruessner J, Czechowska Y, et al. Individual differences in trait anhedonia: a structural and functional magnetic resonance imaging study in non-clinical subjects. *Mol Psychiatry* 2007;12:767–775.

Hayaki J, Hagerty CE, Herman DS, et al. Expectancies and marijuana use frequency and severity among young females. *Addict Behav* 2010;35:995–1000.

Hayes AF. Beyond Baron and Kenny: statistical mediation analysis in the new millennium. *Commun Monogr* 2009;76:408–420.

Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach. New York, NY: Guilford Press, 2013.

Hayes AF, Preacher KJ. Statistical mediation analysis with a multicategorical independent variable [published online ahead of print November 5, 2013]. *Br J Math Stat Psychol* doi: 10.1111/bmsp.12028.

Heinz AJ, Peters EN, Boden MT, et al. A comprehensive examination of delay discounting in a clinical sample of cannabis-dependent military veterans making a self-guided quit attempt. *Exp Clin Psychopharmacol* 2013;21:55–65.

Iversen L. Cannabis and the brain. *Brain* 2003;126:1252–1270.

Jones BT, Corbin W, Fromme K. A review of expectancy theory and alcohol consumption. *Addiction* 2001;96:57–72.

Kang HK, Bullman T. Risk of suicide among US veterans after returning from the Iraq or Afghanistan war zones. *J Am Med Assoc* 2008;300:652–653.

Kassel J, Wardle M, Heinz A, Greenstein J. Cognitive theories of drug effects on emotion. In: Substance Abuse and Emotion. Washington, DC: American Psychological Association, 2010:61–82.

Kilbey M, Downey K, Breslau N. Predicting the emergence and persistence of alcohol dependence in young adults: the role of expectancy and other risk factors. *Exp Clin Psychopharm* 1998;6:149–156.

Leventhal AM, Schmitz J. The role of drug use outcome expectancies in substance abuse risk: an interactional-transformational model. *Addict Behav* 2006;31:2038–2062.

Leventhal AM, Zvolensky MJ, Schmidt NB. Smoking-related correlates of depressive symptom dimensions in treatment-seeking smokers. *Nicotine Tob Res* 2011;13:668–676.

Lobbestael J, Leurgans M, Arntz A. Inter-rater reliability of the Structured Clinical Interview for *DSM-IV* Axis I disorders (SCID I) and Axis II disorders (SCID II). *Clin Psychol Psychother* 2011;18:75–79.

McCarthy JF, Valenstein M, Kim HM, et al. Suicide mortality among patients receiving care in the Veterans Health Administration health system. *Am J Epidemiol* 2009;169 1033–1038.

Nazarian D, Kimerling R, Frayne SM. Posttraumatic stress disorder, substance use disorders, and medical comorbidity among returning U.S. veterans. *J Trauma Stress* 2012;25:220–225.

Norberg MM, Mackenzie J, Copeland J. Quantifying cannabis use with the timeline followback approach: a psychometric evaluation. *Drug Alcohol Depend* 2012;121:247–252.

Norman S, Inaba R, Smith T, et al. Development of the PTSD-Alcohol Expectancy Questionnaire. *Addict Behav* 2008;33:841–847.

Preacher KJ, Hayes AF. SPSS and SAS procedures for estimating indirect effects in simple mediator models. *Behav Res Meth Instrum Comput* 2004;36:717–731.

Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods* 2008;40:879–891.

Prisciandaro JJ, Roberts JE. A comparison of the predictive abilities of dimensional and categorical models of unipolar depression in the National Comorbidity Survey. *Psychol Med* 2009;39:1087–1096.

Ritter C, Clayton RR, Voss HL. Vietnam military service and marijuana use. *Am J Drug Alcohol Abuse* 1985;11:119–130.

Schafer J, Brown SA. Marijuana and cocaine effect expectancies and drug use patterns. *J Consult Clin Psychol* 1991;59:558–565.

Shafer A. Meta-analysis of the factor structures of four depression questionnaires: Beck, CES-D, Hamilton, and Zung. *J Clin Psychol* 2006;62:123–146.

Simons JS, Arens AM. Moderating effects of sensitivity to punishment and sensitivity to reward on associations between marijuana effect expectancies and use. *Psychol Addict Behav* 2007;21:409–414.

Skidmore WC, Roy M. Practical considerations for addressing substance use disorders in veterans and service members. *Soc Work Health Care* 2011;50:85–107,

Sobell LC, Sobell MB. Timeline Follow-Back: a technique for assessing self-reported alcohol consumption. In: Litten RZ, Allen JP, eds. Measuring Alcohol Consumption: Psychosocial and Biochemical Methods. Totowa, NJ: Humana Press, 1992:41–72.

Watson D, O'Hara MW, Simms LJ, et al. Development and validation of the Inventory of Depression and Anxiety Symptoms (IDAS). *Psychol Assess* 2007;19:253–268.