

Anxious Arousal and Anhedonic Depression Symptoms and the Frequency of Current Marijuana Use: Testing the Mediating Role of Marijuana-Use Coping Motives Among Active Users*

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ABSTRACT. Objective: The present investigation examined anxious arousal and anhedonic depression symptoms in relation to frequency of past-30-day marijuana use, as well as the role of marijuana-use coping motives in terms of mediating this relation. **Method:** The present sample included current young adult marijuana users ($N = 154$; 48.1% female; mean [SD] age = 20.75 [5.97] years) who were recruited via study flyers and printed advertisements in local newspapers placed throughout the Burlington, VT, community. **Results:** After controlling for daily cigarette smoking rate, alcohol consumption, and gender, anxious arousal

symptoms, but not anhedonic depression symptoms, were significantly and uniquely associated with the frequency of marijuana use. In addition, coping motives for marijuana use mediated the relation between anxious arousal symptoms and the frequency of current marijuana use. **Conclusions:** These results provide novel information related to the explanatory role of marijuana-use coping motives in the relation between anxious arousal symptoms and the frequency of marijuana use among young adult active users. Clinical implications for the current findings are discussed. (*J. Stud Alcohol Drugs* 70: 543-550, 2009)

MARIJUANA CONTINUES TO BE THE MOST commonly used illicit drug in the United States and the world (Patton et al., 2002; Substance Abuse and Mental Health Services Administration, 2004). Approximately 25 million people in the United States (8.6% of the population), for example, have reported using marijuana within the past year (Johnston et al., 2005). Of those reported users, an estimated 10% will go on to become daily users of the drug (Johnston et al., 1995). Given numerous negative consequences (e.g., increased risk of severe medical disease, increased risk-taking behavior, and clinically significant life impairment) associated with more frequent (e.g., daily, weekly) marijuana use over time, the prevalence of marijuana use and its disorders has continued to be a global public health concern (Bloom et al., 1987; McDonald et al., 2003; Stephens et al., 1993).

One facet of scientific attention in the study of marijuana has been devoted to understanding whether frequent (e.g., daily, weekly) marijuana use may increase an individual's vulnerability for developing and maintaining depressive and anxiety symptoms and disorders (Chen et al., 2002; Green and Ritter, 2000; Thomas, 1996; Tunving, 1985; Zvolensky et al., 2006b). Interestingly, research within this area has been equivocal. For example, although marijuana use has been related to an increased risk of depressive symptoms and disorders (Chen et al., 2002; Hall and Solowij, 1998), the majority of such empirical work indicates that the strength of such associations is markedly attenuated, and often non-existent, after controlling for demographic variables such as gender (Brook et al., 2001; Degenhardt et al., 2001). In terms of anxiety and its disorders, relatively more consistent relations have been evident between frequent or more severe marijuana-use problems (e.g., marijuana dependence) and panic psychopathology (Hollister, 1986; Thomas, 1996; Tunving, 1985). For example, Hathaway (2003) found that among weekly users of marijuana ($N = 140$), approximately 40% reported having had at least one panic attack related to such use. Other studies have found that marijuana dependence is related to an increased risk of panic psychopathology in cross-sectional and prospective work (Zvolensky et al., 2006b; Zvolensky et al., 2008).

Although research focusing on marijuana use and its prediction of depressive and anxiety symptoms and disorders has been informative, far less scholarly efforts have

Received: October 23, 2008. Revision: December 15, 2008.

*This research was supported by National Institute on Drug Abuse research grants 1 R01 MH076629-01, 1 R01 DA018734-01A1, and R03 DA16307-01 awarded to Michael J. Zvolensky. Marcel O. Bonn-Miller also acknowledges that this work was supported in part by Veterans Affairs Office of Academic Affairs and Health Services Research and Development Service Research funds.

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examined depressive and anxiety symptoms in the prediction of frequency of marijuana use among current users of the drug. This neglect of study is surprising, as marijuana users frequently report relief from tension (Hathaway, 2003; Reilly et al., 1998) and negative affect (Schafer and Brown, 1991) as primary reasons for use. There is evidence that depressive symptoms prospectively predict greater levels of marijuana use among adolescents (Repetto et al., 2008). Other studies have found that certain anxiety symptoms, namely those of somatic origin, are associated with greater degrees of current marijuana use among active users (Zvolensky et al., 2006c). These data, although limited in overall scope, suggest that depressive and anxiety symptoms may be related to greater concurrent marijuana use among active users of the drug.

Despite the documented association between depressive and anxiety symptoms and greater levels of frequency of marijuana use, there is little understanding of possible mediators of this relation. Motivational models of substance use predict that distinct motives theoretically may be related to particular types of problems or individual emotional vulnerability characteristics (Cooper, 1994). With regard to marijuana use, several distinct motives have been identified, including enhancement (e.g., "because it's exciting"), conformity (e.g., "to fit in with the group I like"), expansion (e.g., "to expand my awareness"), coping (e.g., "to forget my worries"), and social motives (e.g., "because it makes social gatherings more fun"; Chabrol et al., 2005; Simons et al., 1998; Zvolensky et al., 2007). Of the marijuana-use motives, coping motives are theoretically and clinically the most relevant for better understanding the interconnection between anxiety/depressive states and marijuana use (Zvolensky et al., 2006a), as recent research has consistently demonstrated that coping motives are incrementally related to current substance use and specific cognitive-affective factors (e.g., anxiety sensitivity; Zvolensky et al., 2007). Indeed, from an emotion-regulatory perspective, coping-based marijuana use could represent a method of "psychological control" for personally threatening stimuli (Zvolensky et al., 2006c). Here, coping motives for marijuana use may serve as a mechanism for escaping or avoiding distressing anxiety and depressive states. Thus, individuals suffering from greater levels of anxiety and depressive symptoms may use marijuana as a mood-management technique. Broadly consistent with this type of perspective, coping motives have been found to mediate the relation between social anxiety and marijuana-use problems (Buckner et al., 2007) as well as the relation between the expectancy that marijuana use will regulate negative affect and the number of marijuana-use problems (Simons et al., 2005). It is presently unclear, however, if coping motives for marijuana use mediates the association between anxiety and depressive symptoms and frequency of marijuana use among active users.

To the extent that anxiety and depressive symptoms are related to the frequency of marijuana use, it is possible that

such an association can be at least partially explained by coping motives for such use (mediational effect). Consistent with contemporary models of mediation (Kraemer et al., 2001), this hypothesized association is tested by the examination of coping motives for marijuana use as a mediator of the relation between anxiety and depressive symptoms and frequency of marijuana use (Baron and Kenny, 1986). Here, a significant relation between the predictor (i.e., anxiety or depressive symptoms) and the criterion (i.e., frequency of marijuana use) is said to be mediated when the introduction of a third variable (i.e., coping motives) results in the non-significance of the initial relation (Baron and Kenny, 1986).

In the present investigation, young adult marijuana users, as opposed to those in other age groups, were the target population given that marijuana use is the most prevalent among this segment of the population (Johnston et al., 2002). Accordingly, the current study tested the hypotheses that, among individuals actively using marijuana, greater anxiety and depressive symptoms would predict a greater frequency of current (past-30-day) marijuana use, even after controlling for tobacco and alcohol use as well as gender. It was further hypothesized that coping motives for marijuana use would mediate (explain) the relation between anxiety and depressive symptoms and the frequency of current marijuana use.

Method

Participants

Participants consisted of 154 young adults (48.1% female; mean [SD] age = 20.75 [5.97] years; range: 18-61 years) who were recruited from the community and were current marijuana users (e.g., those who had used marijuana in the past 30 days). Generally consistent with the racial distribution of Vermont (Vermont Department of Health, 2007), 94.8% of participants identified as white, 0.6% as African American, 0.6% as Asian, 0.6% as Hispanic, 0.6% as biracial or multi-racial, and 1.5% as other; 1.3% did not provide ethnic data. Sixty-six percent of the sample smoked marijuana at least once per week, and 22.7% smoked more than once per day. The mean age for first-time marijuana use was 14.97 (2.29) years, and the mean age at onset for regular marijuana use was 15.4 (4.78) years. Thirty-one percent of the sample met diagnostic criteria for marijuana abuse, and 29% met criteria for marijuana dependence according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994). The remaining 40% of the sample were marijuana users who did not meet diagnostic criteria for a marijuana-use disorder.

Fifty-eight percent of the participants smoked cigarettes on a daily basis, averaging 12.9 (13.61) cigarettes per day. Cigarette smoking status was verified for all participants by carbon monoxide analysis at 10 ppm cutoff (Cocores, 1993). Participants identified as smokers reported smoking their first

cigarette at age 13.88 (3.49) years and smoking daily at age 16.27 (3.67) years. Ninety-one percent of the participants reported the current use of alcohol. On average, participants endorsed drinking 2-3 days per week, and consumed an average of five to six drinks per occasion. Additionally, participants scored an average of 11.87 (5.65) on the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 1992), indicating that 63.3% of participants met criteria for at least moderate alcohol problems.

Participants were eligible for enrollment in the present study if they endorsed marijuana use within the past 30 days and were between the ages of 18 and 65 years. Participants were excluded based on the following criteria: (1) current Axis I psychopathology; (2) current use of psychotropic medication; (3) current suicidality or homicidality; (4) current or past chronic cardiopulmonary illness (e.g., chronic obstructive pulmonary disease, severe asthma); (5) current acute respiratory illness (e.g., bronchitis); (6) seizure disorder, cardiac dysfunction, or other serious medical illness (e.g., history of seizures, emphysema); (7) pregnancy (females); and (8) limited mental competency or inability to give informed, written consent.

Measures

The Structured Clinical Interview–Non-Patient Version for DSM-IV (SCID-N/P; First et al., 1996) was administered as a screener to rule out psychopathology and assess current suicidal ideation (discussion of exclusionary criteria follows). In addition, current marijuana abuse and dependence (with the inclusion of substance-withdrawal criteria as defined by the DSM-IV for other drugs and as assessed by the SCID-N/P for other drug classes) was determined using the SCID-N/P.

Marijuana smoking history was assessed with the Marijuana Smoking History Questionnaire (Bonn-Miller and Zvolensky, 2005). The Marijuana Smoking History Questionnaire is a self-report instrument that assesses marijuana smoking rate (lifetime and past 30 days), age at onset of initiation, years of being a regular marijuana smoker, and other descriptive information (e.g., number of attempts to discontinue using marijuana). The Marijuana Smoking History Questionnaire has been employed successfully in the past as a descriptive measure of marijuana-use history and pattern (Bonn-Miller et al., 2005; Zvolensky et al., 2006c) and was employed in the present investigation to determine the frequency of marijuana use over the past 30 days.

The Smoking History Questionnaire (Brown et al., 2002) is a self-report questionnaire used to assess cigarette smoking history and pattern. The Smoking History Questionnaire includes items pertaining to smoking rate, age at onset of smoking initiation, and years of being a daily smoker. The Smoking History Questionnaire also assesses information regarding attempts to quit, including problematic symptoms

experienced during such attempts. The Smoking History Questionnaire has been successfully used in previous studies as a measure of smoking history, pattern, and symptom problems during quitting (Zvolensky et al., 2004). The current investigation used the Smoking History Questionnaire to determine rate of cigarette smoking.

The AUDIT is a 10-item self-report screening measure developed by the World Health Organization to identify individuals with alcohol problems (Babor et al., 1992). There is a large body of literature attesting to the reliability and validity of the AUDIT (e.g., Saunders et al., 1993). In the present study, the frequency and quantity items from the AUDIT were used to index current alcohol consumption (an average frequency-by-quantity composite score; Stewart et al., 2001). Additionally, the AUDIT total score was used to identify current difficulties with alcohol use (Babor et al., 1992).

Marijuana motives for use were assessed with the Marijuana Motives Measure (Simons et al., 1998). The Marijuana Motives Measure is a 25-item measure in which respondents indicate on a 5-point Likert-type scale (1 = almost never/never, to 5 = almost always/always) the degree to which they have smoked marijuana for a variety of possible reasons (e.g., “to be sociable”). Factor analysis of the scale indicates that it has five first-order factors entitled enhancement (e.g., “because it’s exciting”), conformity (e.g., “to fit in with the group I like”), expansion (e.g., “to expand my awareness”), coping (e.g., “to forget my worries”), and social (e.g., “because it makes social gatherings more fun”; Simons et al., 1998; Zvolensky et al., 2007). The Marijuana Motives Measure has high levels of internal consistency for each of the five factors (range of α coefficients: .72-.92) and has been successfully used in the past to measure motivation for using marijuana (Chabrol et al., 2005). Only the coping subscale was used in the present investigation.

The Mood and Anxiety Symptom Questionnaire (Watson et al., 1995) is a 62-item measure of affective symptoms. Participants indicate how much they have experienced each symptom during the past week on a 5-point Likert-type scale (1 = not at all to 5 = extremely). Factor analysis indicates that this scale taps distinct anxiety-depression symptom domains. The anxious arousal subscale of the Mood and Anxiety Symptom Questionnaire measures symptoms of somatic tension and arousal (e.g., “felt dizzy”). The anhedonic depression subscale measures a loss of interest in life (e.g., “felt nothing was enjoyable”), and reverse-keyed items measure positive affect. The Mood and Anxiety Symptom Questionnaire shows excellent convergence with other measures of anxiety and depression and good discriminative validity for anxious versus depressive symptoms via the Mood and Anxiety Symptom Questionnaire–anxious arousal and anhedonic depression subscales, respectively (Watson et al., 1995). The Mood and Anxiety Symptom Questionnaire–anxious arousal and anhedonic depression subscales displayed

TABLE 1. Zero-order correlations among theoretically relevant variables

Variable	1	2	3	4	5	6	7	Mean (SD) or %	Observed range
1. Cigs/day	1	-.00	-.17 [†]	.03	.21 [‡]	.17 [†]	.30 [‡]	12.90 (13.61)	0-120
2. Alcohol		1	-.29 [‡]	.23 [‡]	-.05	-.27 [‡]	.08	8.49 (4.54)	0-20
3. Gender			1	-.19 [†]	-.15	.16 [†]	-.01	48.1% (female)	–
4. MJ				1	.22 [‡]	-.04	.39 [‡]	4.81 (2.28)	1-8
5. MASQ-AA					1	.23 [‡]	.37 [‡]	23.03 (5.93)	17-48
6. MASQ-AD						1	.26 [‡]	52.25 (11.68)	28-86
7. Coping motives							1	2.00 (0.95)	1-5

Notes: Cigs/day = average number of cigarettes smoked per day; alcohol = alcohol consumption (Frequency × Quantity); MJ = frequency of marijuana use; MASQ-AA = Mood and Anxiety Symptom Questionnaire–anxious arousal subscale (Watson et al., 1995); MASQ-AD = Mood and Anxiety Symptom Questionnaire–anhedonic depression subscale (Watson et al., 1995); coping motives = Marijuana Motives Measure–coping subscale (Simons et al., 1998).

[†] $p < .01$; [‡] $p < .001$.

good internal consistency (α coefficients = .82 and .89, respectively) and were used to index anxiety and depressive symptoms, respectively, in the present investigation.

Procedure

Participants were recruited from the Burlington, VT, community for involvement in a study on emotion via placement of study flyers throughout various community settings and posting of printed advertisements in local newspapers. Interested participants who contacted the research team about the study were given a detailed description of the investigation via telephone and were scheduled for a laboratory visit. At arrival, participants completed a written informed consent, which explained study protocol and procedures. Additionally, participants were administered the SCID-N/P (First et al., 1996) by trained interviewers to assess for current Axis I psychopathology. If eligible, participants then completed a battery of self-report measures. At the completion of the study, participants were debriefed and compensated \$20 for their time and effort.

Data analytic strategy

Two separate hierarchical multiple regression analyses were conducted to determine the relations between the studied emotion variables and frequency of marijuana use. Specifically, for both models, cigarettes smoked per day, average alcohol consumption over the past year, and gender were entered at Level 1 of the regression; the Mood and Anxiety Symptom Questionnaire–anxious arousal and anhedonic depression subscale scores were each separately entered at Level 2 in the two separate hierarchical regressions. The criterion variable for both regressions was frequency of marijuana use (past 30 days). These hierarchical models test the incremental main effects of each of the predictor variables, independent of the covariates, in relation to the criterion variable of frequency of marijuana use (Haynes and Lench, 2003). In addition, a series of hierarchical multiple regressions were conducted to test whether marijuana-use coping

motives mediated the relation between anxious arousal and frequency of marijuana use (a detailed description of the analytic rationale follows). Overall, this analytic approach is consistent with general recommendations for mediational analysis (Preacher and Hayes, 2004).

Results

Table 1 presents descriptive data and zero-order (or bivariate, as applicable) correlations among studied variables. Initially, a hierarchical linear regression was conducted to examine the relation between anxious arousal (the predictor) and frequency of marijuana use (the criterion). Daily tobacco use as well as alcohol consumption and gender were included as covariates at Step 1 of the model and anxious arousal was entered at Step 2. Overall, the model predicted 14.7% of variance in the frequency of marijuana use ($F = 5.64$, 1/131 df, $p < .05$). Step 1 of the model predicted 11.4% of variance, with alcohol consumption ($t = 3.43$, $\beta = .30$, $p < .001$) being the only significant predictor. Step 2 accounted for an additional 3.3% of variance, and, as hypothesized, anxious arousal was a significant predictor of frequency of marijuana use above and beyond the covariates at Step 1 of the model ($t = 2.24$, $\alpha = .19$, $p < .05$; see Table 2).

A second hierarchical linear regression was conducted to examine the relation between anhedonic depression (the predictor) and frequency of marijuana use (the criterion). Daily tobacco use as well as alcohol consumption and gender were included as covariates at Step 1 of the model and anxious arousal was entered at Step 2. Overall, the model predicted 9.4% of variance in the frequency of marijuana use ($F = 3.50$, 1/134 df, $p < .01$). Step 1 of the model predicted 9.4% of variance, with alcohol consumption ($t = 3.14$, $\beta = .28$, $p < .01$) being the only significant predictor. Step 2 revealed that anhedonic depression was not a significant predictor of frequency of marijuana use above and beyond the covariates at Step 1 ($t = 0.19$, $\beta = .02$, $p = \text{NS}$; see Table 2).

Another hierarchical linear regression was conducted to examine the relation between anxious arousal (the predictor) and coping motives for marijuana use (the mediator). Similar

TABLE 2. Hierarchical regression analyses: frequency of marijuana use

Step	ΔR^2	t	β	sr^2	p
Step 1	.11				<.001
Cigs/day		1.35	.11	.00	NS
Alcohol		3.43	.30	.01	<.001
Gender		-0.49	-.04	.08	NS
Step 2	.03				<.001
MASQ-AA		2.24	.19	.04	<.05
Step 1	.09				<.01
Cigs/day		0.92	.08	.00	NS
Alcohol		3.14	.28	.01	<.01
Gender		-0.51	-.05	.07	NS
Step 2	.00				NS
MASQ-AD		0.19	.02	.00	NS

Notes: β = standardized beta weight provided for hierarchical multiple regression; sr^2 = squared partial correlation; cigs/day = average number of cigarettes smoked per day; NS = not significant; alcohol = alcohol consumption (Frequency \times Quantity); MASQ-AA = Mood and Anxiety Symptom Questionnaire-anxious arousal subscale (Watson et al., 1995); MASQ-AD = Mood and Anxiety Symptom Questionnaire-anhedonic depression subscale (Watson et al., 1995).

to prior analyses, daily tobacco use as well as alcohol consumption and gender were included as covariates at Step 1 of the model and anxious arousal was entered at Step 2. The model predicted 21.3% of variance in coping motives ($F = 8.85$, 1/131 df, $p < .001$). Step 1 of the model predicted 12.6% of variance, with alcohol consumption ($t = 2.66$, $\beta = .23$, $p < .01$) and cigarettes per day ($t = 3.69$, $\beta = .31$, $p < .001$) being significant predictors of coping motives. Step 2 accounted for an additional 8.7% of variance and, as hypothesized, anxious arousal was a significant predictor above and beyond the variance accounted for in Step 1 of the model ($t = 3.80$, $\beta = .31$, $p < .001$; see Table 3).

A final hierarchical linear regression was conducted to examine the relation between anhedonic depression (the pre-

TABLE 3. Hierarchical regression analyses: Marijuana-use coping motives

Step	ΔR^2	t	β	sr^2	p
Step 1	.13				<.001
Cigs/day		3.69	.31	.02	<.001
Alcohol		2.66	.23	.09	<.01
Gender		1.55	.14	.07	NS
Step 2	.09				<.001
MASQ-AA		3.80	.31	.10	<.001
Step 1	.10				<.01
Cigs/day		3.27	.27	.01	<.001
Alcohol		2.40	.21	.07	<.05
Gender		1.40	.12	.04	NS
Step 2	.06				<.001
MASQ-AD		3.17	.26	.07	<.01

Notes: β = standardized beta weight provided for hierarchical multiple regression; sr^2 = squared partial correlation; cigs/day = average number of cigarettes smoked per day; alcohol = alcohol consumption (Frequency \times Quantity); NS = not significant; MASQ-AA = Mood and Anxiety Symptom Questionnaire-anxious arousal subscale (Watson et al., 1995); MASQ-AD = Mood and Anxiety Symptom Questionnaire-anhedonic depression subscale (Watson et al., 1995).

TABLE 4. Regression analyses testing for mediation: (1) effect of anxious arousal on frequency of marijuana use after controlling for covariates, (2) effect of anxious arousal on coping motives (mediator) after controlling for covariates, (3) effect of coping motives on frequency of marijuana use after controlling for anxious arousal and other covariates, and (4) effect of anxious arousal on frequency of marijuana use after controlling for coping motives and other covariates

Independent variable(s)	Dependent variable	β	F
1. Cigs/day (Step 1)	Frequency of marijuana use	.11	5.67 [†]
Alcohol (Step 1)		.30	
Gender (Step 1)		-.04	
MASQ-AA		.19	5.02*
2. Cigs/day (Step 1)	Coping motives	.31	6.34 [†]
Alcohol (Step 1)		.23	
Gender (Step 1)		.14	
MASQ-AA		.31	14.46 [†]
3. Cigs/day (Step 1)	Frequency of marijuana use	.07	5.64 [†]
Alcohol (Step 1)		.30	
Gender (Step 1)		-.02	
MASQ-AA (Step 1)		.19	
Coping motives		.30	12.07 [†]
4. Cigs/day (Step 1)	Frequency of marijuana use	.01	8.80 [†]
Alcohol (Step 1)		.22	
Gender (Step 1)		-.10	
Coping Motives (Step 1)		.33	
MASQ-AA		.09	1.25

Notes: β = standardized beta weight provided for hierarchical multiple regression; F = change in F statistic provided for hierarchical multiple regression (only one F statistic is reported for each step); cigs/day = average number of cigarettes smoked per day; alcohol = alcohol consumption (Frequency \times Quantity); coping motives = Marijuana Motives Measure-coping subscale (Simons et al., 1998); MASQ-AA = Mood and Anxiety Symptom Questionnaire-anxious arousal subscale (Watson et al., 1995).

* $p < .05$; [†] $p < .01$.

dicator) and coping motives for marijuana use (the mediator). Daily tobacco use as well as alcohol consumption and gender were included as covariates at Step 1 of the model and anhedonic depression was entered at Step 2. Here, 16.5% of variance in the frequency of marijuana use was explained ($F = 6.63$, 1/134 df, $p < .001$). Step 1 of the model predicted 10.2% of variance, with alcohol consumption ($t = 2.40$, $\beta = .21$, $p < .05$) and cigarettes per day ($t = 3.27$, $\beta = .27$, $p < .001$) being significant predictors. Step 2 accounted for an additional 6.3% of variance and anhedonic depression was a significant predictor of coping motives above and beyond the variance accounted for in Step 1 of the model ($t = 3.17$, $\beta = .26$, $p < .01$; see Table 3).

As described in Table 4, the mediational role of coping motives in the relation between anxious arousal and frequency of marijuana use was examined by employing the strategy proposed by Baron and Kenny (1986). The first requirement of this statistical test of mediation rests with an association between the predictor variable (anxious arousal) and criterion variable (frequency of marijuana use). This association was found to be statistically significant (see Analysis 1 in Table 4). The second requirement for mediation involves establishing a relation between the predictor variable and the proposed mediating variable (coping motives). Again, this association was found to be statistically significant (see

Analysis 2 in Table 4). The third requirement states that a relation between the proposed mediating variable and the criterion variable must exist after controlling for the effects of the predictor. After controlling for anxious arousal, coping motives were significantly associated with frequency of marijuana use (see Analysis 3 in Table 4). The final requirement for mediation involves evaluating the relation between the predictor and the criterion when the variance accounted for by the proposed mediator has been removed. When this equation yields a nonsignificant effect for the predictor, the controlling variable is said to fully mediate the relation. In these analyses, coping motives mediated the relation between anxious arousal and frequency of marijuana use (see Analysis 4 in Table 4).

As mediational analyses are often conducted using longitudinal data, one powerful method of strengthening the interpretation of mediational analyses conducted with cross-sectional data is to conduct an additional analysis reversing the proposed mediator and criterion variable (Preacher and Hayes, 2004; Sheets and Braver, 1999; Shrout and Bolger, 2002). Here, we evaluated whether frequency of marijuana use mediated the relation between anxious arousal and coping motives. Results were not consistent with mediation in this direction as anxious arousal remained a significant predictor of coping motives after controlling for frequency of marijuana use ($F = 10.09$, $1/130$ df, $p < .01$).

Discussion

Despite advances in understanding linkages between anxiety and depressive symptoms and the frequency of marijuana use (Repetto et al., 2008), the mechanisms underlying such associations remain unclear. The current study tested coping motives for marijuana use as a mediator of the relation between anxiety and depressive symptoms and the frequency of marijuana use among current young adult users.

Results were partially consistent with the original hypotheses. Specifically, anxious arousal symptoms, but not anhedonic depression symptoms, were significantly and uniquely related to the frequency of marijuana use. The effect of anxious arousal symptoms represented approximately 3% of unique variance and was apparent after controlling for the significant variance accounted for daily cigarette smoking, alcohol consumption, and gender (Level 1). Also consistent with prediction, coping motives for marijuana use mediated the relation between anxious arousal symptoms and frequency of current marijuana use. Although the cross-sectional nature of the research design does not allow us to disentangle whether coping motives occur after anxious arousal symptoms (Baron and Kenny, 1986), the present findings provide data consistent with a coping-derived mediational model. We attempted to strengthen confidence in this observation by evaluating an alternative model in which frequency of marijuana use mediated the relation between

anxious arousal symptoms and coping motives. No support was found for such a model. Because anhedonic depression symptoms were not related to frequency of marijuana use, it was therefore not submitted to formal mediational analysis.

The current findings suggest that coping motives for marijuana use are important to consider in the relation between anxious arousal symptoms and frequency of marijuana use among active users of the drug. Because the temporal precedence cannot be established (i.e., higher levels of anxious arousal symptoms leading to greater coping motives for marijuana use), the current findings could be due to a variety of permutations of temporal ordering of the studied variables. However, the present data point to the possible relevance of coping motives for marijuana use as a theoretically viable mechanism within an anxiety–marijuana use relationship. These findings are broadly consistent with theoretical models of marijuana–anxiety co-occurrence (Zvolensky et al., 2006a) and empirical work focused on affect vulnerability variables and marijuana-use problems (Buckner et al., 2007; Simons et al., 2005). However, the finding that anhedonic depressive symptoms were not related to the frequency of marijuana use among this adult sample of active users is not in accord with some past observations (Repetto et al., 2008). There are a variety of methodological factors that could influence the inconsistency between the current study and some past work noting a depressive symptom–marijuana frequency of use relationship, including type of population (e.g., adolescent versus adult; Repetto et al., 2008). Because of the overall paucity of work in this domain, future work is needed to draw more definitive inferences about any possible null finding involving these variables.

The present study has a number of limitations and related future directions that warrant comment. First, the studied marijuana-using participants were a demographically homogeneous, age-limited, self-selected, young adult sample from the community. Thus, it may be fruitful to build from the present research and replicate and extend the current results to independent, more diverse marijuana-using populations from distinct developmental age ranges (e.g., adolescents, older adults) and clinical service centers.

Second, given that self-report measures were used as the assessment methodology, method variance that resulted from the specific single-method approach used may have contributed, in part, to the observed results. To address this concern, future research could employ alternative assessment methodologies that incorporate approaches using multiple methods.

Third, the cross-sectional nature of the current data precludes definitive conclusions regarding the patterning of disorder onset across time. Thus, a prospective test of the mediational role of coping motives for marijuana use is a useful next research step. Moreover, building from the current study, future work is poised to making further exciting inroads into this domain of study by exploring the empirical

merit of more complex modes. For example, it is possible that other motives of marijuana use may interact with or moderate psychological distress (e.g., anxiety, depression) in regard to the frequency of marijuana use.

Fourth, we sampled for nonclinical persons (without Axis I disorders, with the exception of substance-use disorders). This methodological strategy was designed to rule out possible explanatory confounds between psychopathology and the studied emotional vulnerability variables. That is, because each of these emotional vulnerability factors covaries with psychopathology, the inclusion of participants with psychopathology would have potentially obfuscated pinpointing the relations between anxious arousal symptoms, anhedonic depression symptoms, and marijuana-use coping motives. Although this emphasis on internal validity can be viewed as a strength of the study, it would nonetheless be beneficial to replicate and extend the results to a clinical sample of marijuana users.

Finally, as previously noted, current Axis I psychopathology was excluded from the present investigation; however, we allowed for concurrent use of other substances (e.g., tobacco, alcohol). Thus, there are relatively high rates of alcohol use among our sample. Consistent with past research, our sample reflects the common co-occurrence of the use of marijuana and alcohol. Indeed, the International Consortium of Psychiatric Epidemiology reported that cannabis and alcohol were the two most commonly used substances across six international sites (including the United States; Vega et al., 2002).

Overall, the present study provides novel empirical information concerning anxious arousal symptoms, anhedonic depression symptoms, and marijuana coping motives in terms of their relation to the frequency of marijuana use among young adult marijuana users. Results indicated that coping motives for marijuana use mediated the relation between anxious arousal symptoms and frequency of current marijuana use. These results provide novel information related to the role of anxious arousal symptoms and marijuana coping motives as they pertain to the frequency of marijuana use among young adults. Although still in its infancy, such data highlight potential points of intervention for frequent and potentially problematic marijuana use. Specifically, building from such work, it is possible that coping-based motives for marijuana use also may need to be addressed as part of clinical care for active users with anxiety-related difficulties who are attempting to quit using marijuana. Indeed, without addressing marijuana use as a coping mechanism, interventions may not be maximizing efforts to change behavior.

References

AMERICAN PSYCHIATRIC ASSOCIATION. Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), Washington, DC, 1994.

BABOR, T.F., DE LA FUENTE, J.R., SAUNDERS, J., AND GRANT, M. AUDIT: The

Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Health Care, Revision, WHO Documentation No. WHO/PSA/92.4, Geneva, Switzerland: World Health Organization, 1992.

BARON, R.M. AND KENNY, D.A. The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *J. Pers. Social Psychol.* **51**: 1173-1182, 1986.

BLOOM, J.W., KALTENBORN, W.T., PAOLETTI, P., CAMILLI, A., AND LEBOWITZ, M.D. Respiratory effects of non-tobacco cigarettes. *Brit. Med. J.* **295**: 1516-1518, 1987.

BONN-MILLER, M.O. AND ZVOLENSKY, M.J. The Marijuana Smoking History Questionnaire (available on request), Burlington, VT: The Anxiety and Health Research Laboratory, University of Vermont, 2005, unpublished manuscript.

BONN-MILLER, M.O., ZVOLENSKY, M.J., LEEN-FELDNER, E.W., FELDNER, M.T., AND YARTZ, A.R. Marijuana use among daily tobacco smokers: Relationship to anxiety-related factors. *J. Psychopathol. Behav. Assess.* **27**: 279-289, 2005.

BROOK, J.S., ROSEN, Z., AND BROOK, D.W. The effect of early marijuana use on later anxiety and depressive symptoms. *NYS Psychol.* **13**: 35-40, 2001.

BROWN, R.A., LEJUEZ, C.W., KAHLER, C.W., AND STRONG, D.R. Distress tolerance and duration of past smoking cessation attempts. *J. Abnorm. Psychol.* **111**: 180-185, 2002.

BUCKNER, J.D., BONN-MILLER, M.O., ZVOLENSKY, M.J., AND SCHMIDT, N.B. Marijuana use motives and social anxiety among marijuana-using young adults. *Addict. Behav.* **32**: 2238-2252, 2007.

CHABROL, H., DUCONGE, E., CASAS, C., ROURA, C., AND CAREY, K.B. Relations between cannabis use and dependence, motives for cannabis use and anxious, depressive and borderline symptomatology. *Addict. Behav.* **30**: 829-840, 2005.

CHEN, C.-Y., WAGNER, F.A., AND ANTHONY, J.C. Marijuana use and the risk of major depressive episode: Epidemiological evidence from the United States National Comorbidity Survey. *Social Psychiat. Psychiat. Epidemiol.* **37**: 199-206, 2002.

COCORES, J. Nicotine dependence: Diagnosis and treatment. *Psychiat. Clin. No. Amer.* **16**: 49-60, 1993.

COOPER, M.L. Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychol. Assess.* **6**: 117-128, 1994.

DEGENHARDT, L., HALL, W., AND LYNKEY, M. Alcohol, cannabis and tobacco use among Australians: A comparison of their associations with other drug use and use disorders, affective and anxiety disorders, and psychosis. *Addiction* **96**: 1603-1614, 2001.

FIRST, M.B., SPITZER, R.L., GIBBON, M., AND WILLIAMS, J.B.W. Structured Clinical Interview for DSM-IV Patient Edition (SCID-P, Version 2.0), New York: Biometrics Research Department, New York Psychiatric Institute, 1996.

GREEN, B.E. AND RITTER, C. Marijuana use and depression. *J. Hlth Social Behav.* **41**: 40-49, 2000.

HALL, W. AND SOLOWIJ, N. Adverse effects of cannabis. *Lancet* **352**: 1611-1616, 1998.

HATHAWAY, A.D. Cannabis effects and dependency concerns in long-term frequent users: A missing piece of the public health puzzle. *Addict. Res. Theory* **11**: 441-458, 2003.

HAYNES, S.N. AND LENCH, H.C. Incremental validity of new clinical assessment measures. *Psychol. Assess.* **15**: 456-466, 2003.

HOLLISTER, L.E. Health aspects of cannabis. *Pharmacol. Rev.* **38**: 1-20, 1986.

JOHNSTON, L.D., O'MALLEY, P.M., AND BACHMAN, J.G. National Survey Results on Drug Use from the Monitoring the Future Study, 1975-1994, NIH Publication No. 95-4026, Washington: Government Printing Office, 1995.

JOHNSTON, L.D., O'MALLEY, P.M., AND BACHMAN, J.G. Monitoring the Future: National Survey Results on Adolescent Drug Use: Overview of Key

- Findings, 2001, NIH Publication No. 02-5105, Bethesda, MD: National Institute on Drug Abuse, 2002.
- JOHNSTON, L.D., O'MALLEY, P.M., BACHMAN, J.G., AND SCHULENBERG, J.E. Monitoring the Future: National Results on Adolescent Drug Use: Overview of Key Findings, 2004, NIH Publication No. 05-5726, Bethesda, MD: National Institute on Drug Abuse, 2005.
- KRAEMER, H.C., STICE, E., KAZDIN, A.E., OFFORD, D., AND KUPFER, D. How do risk factors work together? Mediators, moderators, and independent, overlapping, and proxy risk factors. *Amer. J. Psychiat.* **158**: 848-856, 2001.
- MCDONALD, J., SCHLEIFER, L., RICHARDS, J.B., AND DE WIT, H. Effects of THC on behavioral measures of impulsivity in humans. *Neuropsychopharmacology* **28**: 1356-1365, 2003.
- PATTON, G.C., COFFEY, C., CARLIN, J.B., DEGENHARDT, L., LYNKEY, M., AND HALL, W. Cannabis use and mental health in younger people: Cohort study. *Brit. Med. J.* **325**: 1195-1198, 2002.
- PREACHER, K.J. AND HAYES, A.F. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Meth., Instr. Comput.* **36**: 717-731, 2004.
- REILLY, D., DIDCOTT, P., SWIFT, W., AND HALL, W. Long-term cannabis use: Characteristics of users in an Australian rural area. *Addiction* **93**: 837-846, 1998.
- REPETTO, P.B., ZIMMERMAN, M.A., AND CALDWELL, C.H. A longitudinal study of depressive symptoms and marijuana use in a sample of inner-city African-Americans. *J. Res. Adolesc.* **18**: 421-447, 2008.
- SAUNDERS, J.B., AASLAND, O.G., BABOR, T.F., DE LA FUENTE, J.R., AND GRANT, M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption—II. *Addiction* **88**: 791-804, 1993.
- SCHAFFER, J. AND BROWN, S.A. Marijuana and cocaine effect expectancies and drug use patterns. *J. Cons. Clin. Psychol.* **59**: 558-565, 1991.
- SHEETS, V.L. AND BRAVER, S.L. Organizational status and perceived sexual harassment: Detecting the mediators of a null effect. *Pers. Social Psychol. Bull.* **25**: 1159-1171, 1999.
- SHROUT, P.E. AND BOLGER, N. Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychol. Meth.* **7**: 422-445, 2002.
- SIMONS, J., CORREIA, C.J., CAREY, K.B., AND BORSARI, B.E. Validating a five-factor marijuana motives measure: Relations with use, problems, and alcohol motives. *J. Counsel. Psychol.* **45**: 265-273, 1998.
- SIMONS, J.S., GAHER, R.M., CORREIA, C.J., HANSEN, C.L., AND CHRISTOPHER, M.S. An affective-motivational model of marijuana and alcohol problems among college students. *Psychol. Addict. Behav.* **19**: 326-334, 2005.
- STEPHENS, R.S., ROFFMAN, R.A., AND SIMPSON, E.E. Adult marijuana users seeking treatment. *J. Cons. Clin. Psychol.* **61**: 1100-1104, 1993.
- STEWART, S.H., ZVOLENSKY, M.J., AND EIFERT, G.H. Negative-reinforcement drinking motives mediate the relation between anxiety sensitivity and increased drinking behavior. *Pers. Individ. Diff.* **31**: 157-171, 2001.
- SUBSTANCE ABUSE AND MENTAL HEALTH SERVICES ADMINISTRATION (Office of Applied Studies). Results from the 2003 National Survey on Drug Use and Health: National Findings, DHHS Publication No. (SMA) 04-3964, Rockville, MD: Substance Abuse and Mental Health Services Administration, 2004.
- THOMAS, H. A community survey of adverse effects of cannabis use. *Drug Alcohol Depend.* **42**: 201-207, 1996.
- TUNVING, K. Psychiatric effects of cannabis use. *Acta Psychiat. Scand.* **72**: 209-217, 1985.
- VEGA, W.A., AGUILAR-GAXIOLA, S., ANDRADE, L., BIJL, R., BORGES, G., CARAVEO-ANDUAGA, J.J., DEWIT, D.J., HEERINGA, S.G., KESSLER, R.C., KOLODY, B., MERIKANGAS, K.R., MOLNAR, B.E., WALTERS, E.E., WARNER, L.A., AND WITTCHEN, H.-U. Prevalence and age of onset for drug use in seven international sites: Results from the International Consortium of Psychiatric Epidemiology. *Drug Alcohol Depend.* **68**: 285-297, 2002.
- VERMONT DEPARTMENT OF HEALTH. Burlington, VT: State of Vermont, 2007 (available at: www.healthyvermonters.gov).
- WATSON, D., WEBER, K., ASSENHEIMER, J.S., CLARK, L.A., STRAUSS, M.E., AND MCCORMICK, R.A. Testing a tripartite model: I. Evaluating the convergent and discriminant validity of anxiety and depression symptom scales. *J. Abnorm. Psychol.* **104**: 3-14, 1995.
- ZVOLENSKY, M.J., BERNSTEIN, A., MARSHALL, E.C., AND FELDNER, M.T. Panic attacks, panic disorder, and agoraphobia: Associations with substance use, abuse, and dependence. *Curr. Psychiat. Rep.* **8**: 279-285, 2006a.
- ZVOLENSKY, M.J., BERNSTEIN, A., SACHS-ERICSSON, N., SCHMIDT, N.B., BUCKNER, J.D., AND BONN-MILLER, M.O. Lifetime associations between cannabis, use, abuse, and dependence and panic attacks in a representative sample. *J. Psychiat. Res.* **40**: 477-486, 2006b.
- ZVOLENSKY, M.J., BONN-MILLER, M.O., BERNSTEIN, A., MCLEISH, A.C., FELDNER, M.T., AND LEEN-FELDNER, E.W. Anxiety sensitivity interacts with marijuana use in the prediction of anxiety symptoms and panic-related catastrophic thinking among daily tobacco users. *Behav. Res. Ther.* **44**: 907-924, 2006c.
- ZVOLENSKY, M.J., LEJUEZ, C.W., KAHLER, C.W., AND BROWN, R.A. Nonclinical panic attack history and smoking cessation: An initial examination. *Addict. Behav.* **29**: 825-830, 2004.
- ZVOLENSKY, M.J., LEWINSON, P., BERNSTEIN, A., SCHMIDT, N.B., BUCKNER, J.D., SEELEY, J., AND BONN-MILLER, M.O. Prospective associations between cannabis use, abuse, and dependence and panic attacks and disorder. *J. Psychiat. Res.* **42**: 1017-1023, 2008.
- ZVOLENSKY, M.J., VUJANOVIC, A.A., BERNSTEIN, A., BONN-MILLER, M.O., MARSHALL, E.C., AND LEYRO, T.M. Marijuana use motives: A confirmatory test and evaluation among young adult marijuana users. *Addict. Behav.* **32**: 3122-3130, 2007.