

# Stress as a Moderator of the Effects of Coping Motives on Alcohol and Marijuana Use in Young Adulthood

*Cannabis*

2018, Volume 1 (1), 1-13

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researchmj.org

DOI: 10.26828/cannabis.2018.01.001



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## ABSTRACT

Higher levels of coping motives are associated with higher frequency and quantity of alcohol and marijuana use, and higher levels of stress may exacerbate this association. In this study, we examined whether perceived level of stress moderated the association between coping motives and alcohol and marijuana use in a sample of young adult men. Data came from men who were interviewed at mean age 26 (N = 425) and again at mean age 29 (N = 400). Past year frequency and quantity of drinking and past year frequency of marijuana use were assessed as outcomes. Enhancement motives and race were controlled in the analyses. Hierarchical regression analyses indicated that stronger alcohol coping motives were significantly related to greater frequency and quantity of alcohol use at ages 26 and 29 and stronger marijuana coping motives were significantly related to greater frequency of marijuana use at age 26 but not 29. Coping motives at age 26 were not predictive of alcohol or marijuana use at age 29. Enhancement motives attenuated the effects of coping motives concurrently and were significantly related to all substance-specific outcomes at the same wave. Crossover effects from alcohol coping motives to marijuana use and from marijuana coping motives to alcohol use were not significant at ages 26 or 29. Stress did not moderate the effects of coping on any outcome. Although coping motives were significant substance-specific predictors of alcohol and marijuana use in young adulthood, most of these associations were no longer significant once enhancement motives were controlled. Interventions to challenge both enhancement and coping motives are needed for young men throughout young adulthood.

**Key words:** alcohol use, marijuana use, stress, coping motives, enhancement motives

It is imperative to understand reasons why individuals use substances in order to develop effective interventions to reduce use and related problems. Coping motives, which involve using substances to escape from or avoid unpleasant emotional states, have been identified as the type of motives most directly associated with the experience of negative consequences for both alcohol and marijuana use (Cooper, Kuntsche, Levitt, Barber, & Wolf, 2016). Furthermore, in

accord with a stress-coping model (Wills & Shiffman, 1985), some individuals use substances specifically as a coping response to stress to either increase positive affect and/or decrease negative affect. Thus, higher levels of stress might exacerbate the association between coping motives and negative substance use outcomes. In this study, we examine whether perceived level of stress moderates the association between coping

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motives and alcohol and marijuana use in a sample of young adult men.

### *Motives for Substance Use*

Substance use motives are reasons that individuals endorse for using substances and are proximal predictors of consumption (Cox & Klinger, 1988; Kuntsche, Knibbe, Gmel, & Engels, 2005). Cooper's (1994) four-factor framework of drinking motives has been the most frequently studied in the alcohol literature. In this framework, social motives involve reasons to drink associated with social facilitation; enhancement motives capture reasons associated with fun and pleasure; coping motives indicate drinking to reduce negative affect; and conformity motives relate to drinking to fit-in with peers. Cooper's model fits well for alcohol use among adolescents and young adults (Cooper et al., 2016). Overall, most individuals endorse social and enhancement motives with fewer indicating coping and conformity motives (Cooper et al., 2016; Crutzen, Kuntsche, & Schelleman-Offermans, 2013; Kuntsche et al., 2005). In general, social motives are associated with moderate alcohol use, enhancement motives with heavy drinking, and coping motives with heavier drinking and alcohol-related problems (Cooper et al., 2016; Kuntsche et al., 2005; Schelleman-Offermans, Kuntsche, & Knibbe, 2011). Findings for conformity motives have been less consistent (Cooper et al., 2016; Kuntsche et al., 2005).

Simons, Correia, Carey, and Borsari (1998) developed the Marijuana Motives Measure (MMM) by adding a fifth type of motive to the Cooper framework. The fifth factor, expansion, was added to account for the "psychedelic" effects of marijuana. This framework has been supported in samples of college students and emerging adults (e.g., Bonn-Miller & Zvolensky, 2009; Simons, Correia, & Carey, 2000; Zvolensky et al., 2007). In contrast to alcohol, enhancement motives are most strongly endorsed for marijuana followed by social motives (Cooper et al., 2016). Although less frequently endorsed, marijuana coping motives have been related to more frequent marijuana use and negative consequences (Cooper et al., 2016). For example, in a sample of adult marijuana smokers from the community, Bonn-Miller, Zvolensky, and Bernstein (2007) found that coping motives were uniquely associated with last month marijuana use, even

after controlling for number of years of marijuana use and current alcohol and tobacco use (see also Foster, Buckner, Schmidt, & Zvolensky, 2016; Johnson, Bonn-Miller, Leyro, & Zvolensky, 2009). Furthermore, coping motives have been found to predict marijuana-related problems, even after controlling for use (Buckner, 2013; Lee, Neighbors, & Woods, 2007; Moitra, Christopher, Anderson, & Stein, 2015; Patrick, Bray, & Berglund, 2016), although some studies have not found an association between marijuana coping motives and marijuana-related problems (e.g., Zvolensky et al., 2007).

### *Stress, Coping, and Substance Use*

Research has consistently demonstrated that use of certain substances, such as alcohol, serves a stress-reduction function (Wills & Shiffman, 1985). This type of coping is motivated by a desire to reduce tension, promote relaxation, and avoid problems. Labouvie (1986) found that adolescents who used alcohol and drugs to cope with problems reported the highest frequency and quantity of alcohol and marijuana use. In addition, these same adolescents experienced heightened levels of social and life stress. Wills (1985) also found that problematic drinking was related to subjective stress among adolescents, consistent with the notion of a reciprocal process between stress and coping-related use (Marlatt, 1985). Marijuana use has also been linked to stress and coping. For example, in a sample of emerging adults, Moitra et al. (2015) found a strong relationship between using marijuana to cope and perceived stress. In a study of adolescents, Fox, Towe, Stephens, Walker, and Roffman (2011) found that frequency of marijuana use, internalizing problems, and marijuana coping motives explained the most unique variance in cannabis use dependence (CUD) symptoms.

Researchers have found that individual internalizing factors moderate the association between coping use of substances and higher levels of use and problems. For example, in several studies, young adults who used marijuana to cope, compared to those who did not, experienced greater psychological distress and negative affect (Beck et al., 2009; Fox et al., 2011; Mitchell, Zvolensky, Marshall, Bonn-Miller, & Vujanovic, 2007; Moitra et al., 2015; Zvolensky et al., 2009). Fox et al. (2011) found a significant interaction effect between internalizing behavior

problems and using marijuana to cope with negative affect on CUD symptoms. Specifically, those adolescents who reported lower, rather than higher, levels of internalizing behavior problems and used marijuana to cope reported more symptoms of CUD. Similarly, Holahan, Moos, Holahan, Cronkite, and Randall (2001) found that, over a 10-year period, the associations of anxiety and depression with alcohol consumption and alcohol-related problems were stronger for individuals who used alcohol to cope at baseline (ages 18-88 at baseline) compared to those who did not (see also Holahan, Cronkite, & Randall, 2003).

In a cigarette smoking treatment-seeking sample, Foster and colleagues (2016) examined the extent to which psychological factors (depressive affect, social anxiety) moderated the associations between coping motives and multiple types of substance use (alcohol use, marijuana use). Their study is also unique because they examined the crossover effects of marijuana coping motives on alcohol use as well as alcohol coping motives on marijuana use. This study found that alcohol coping motives were associated with heavier drinking; however, this association was moderated by a significant 3-way interaction between alcohol coping motives X social anxiety X depressive symptoms. The authors' posthoc probing of the interaction suggested that the association between alcohol coping motives and heavier drinking among those with lower social anxiety was only significant among those with high depressive symptoms. However, among those with high social anxiety, alcohol coping motives was significantly associated with heavier drinking for individuals with low or high depressive symptoms. These same three-way interactions did not reach statistical significance for marijuana use. However, marijuana coping motives were marginally associated with greater drinking among those with higher social anxiety and high depressive symptoms. Thus, it appears that negative affect and internalizing problems moderate the association between coping motives and substance use.

It is also possible that levels of stress may moderate this association, that is, that individuals with higher coping motives may drink or use drugs more heavily than their peers with lower coping motives when exposed to stress. Several experimental studies have demonstrated differential responses to stress between

participants high and low in drinking coping motives and interactions between coping and stress or negative mood induction on drinking-related outcomes, such as attentional bias for alcohol cues, craving, and reinforcement value of alcohol (e.g., Birch et al., 2004; Field & Powell, 2007; Field & Quigley, 2009; Grant, Stewart, & Birch, 2007; Rousseau, Irons, & Correria, 2011). Only one laboratory study that we are aware of examined whether response to stress interacted with coping motives to predict alcohol consumption. Thomas, Merrill, Hofe, and Magid (2014) found that, although participants high, compared to low, on drinking coping motives differed in their response to stress (those higher showed less of a response), there were no effects of stress on alcohol consumption and no differential effects for the two groups.

Only a few survey studies have empirically tested this stress moderation hypothesis and only for alcohol. Abbey, Smith, and Scott (1993), in a cross-sectional study of adults, found that coping use of alcohol was more strongly associated with heavy drinking among individuals with moderate or high levels of stress compared to individuals with lower levels of stress. In a longitudinal study of middle-aged adults, Windle and Windle (2015) examined moderating effects among alcohol use, coping motives, and stress on later drinking behavior. They found one significant interaction of stress and coping for men but not for women. Specifically, higher levels of coping motives interacted with higher levels of stress to predict increases in alcohol problems over time and lower levels of coping motives interacted with higher stress to predict lower levels of alcohol problems over time. There were no significant interactive effects of stress by coping on drinking patterns (quantity-frequency and heavy drinking) for men or women. In contrast, there were several significant interactions between earlier drinking and stress and between earlier drinking and coping for both men and women. When the same sample was studied as adolescents, the interaction between major stressful life events and coping drinking motives was not related to alcohol use or alcohol problems (Windle & Windle, 1996).

### *Current Study*

Foster et al. (2016) point to the scarcity of studies that have examined the interactive relations between coping motives and psychological factors across multiple substances. In fact, to our knowledge, their study is the only one to examine psychological moderators (i.e., depressive symptoms, social anxiety) in the context of crossover effects of alcohol and marijuana coping motives on different types of substance use. In this study, we examine the substance-specific and crossover effects of coping motives for alcohol and marijuana examining stress as the moderator. Specifically, we test whether perceived stress moderates the associations between alcohol and marijuana coping motives and alcohol and marijuana frequency use as well as alcohol quantity in a community sample of young adult men. We hypothesize that: 1) stronger coping motives will be associated with higher levels of substance use; 2) for those men with higher, compared to lower, levels of stress, the association between coping motives and greater substance use will be stronger; and 3) substance-specific associations will be stronger than crossover associations.

## METHOD

### *Design and Sample*

We used data from the Pittsburgh Youth Study (PYS), which is a prospective study of the development of delinquency, substance use, and mental health problems (Loeber, Farrington, Southamer-Loeber, & White, 2008). The PYS recruited three cohorts of boys from the Pittsburgh public schools in 1987-1988; only boys were included because of the original focus of the study on delinquency. In this study, we included only the youngest cohort, which was recruited from the incoming first grade class. A random sample of 849 boys were screened for early conduct problems as assessed by self-report, primary caretakers' reports, and teachers' reports. Boys who scored in the top 30% on conduct problems and an approximately equal number randomly selected from the remaining sample were selected for follow-up (N = 503; mean age = 6.9; SD = 0.5). The follow-up sample did not differ significantly from the screening sample on race, family composition, and California Achievement Test reading scores (Pardini et al., 2015). The sample was comprised of

predominately black (55.7%) and white (40.6%) boys. Most primary caregivers were biological mothers (92%) and more than half of the families (61.3%) were receiving public financial assistance (see Loeber et al. [2008] for details).

After screening, youths were interviewed at 6-month intervals for 4 years and then annually for 9 years until mean age 20 (SD = 0.61), with an average completion rate above 90% across the 14 years of data collection. In 2006-2007, follow-up interviews were conducted at mean age 26 (SD = 1.0; N = 427), and in 2009-2010 at mean age 29 (SD = 1.1; N = 402). Eleven men were deceased before the age 26 follow-up (2.2%), and a total of 16 men were deceased before the age 29 assessment (3.2% of initial sample). Of the men who were alive at the time of the age 26 follow-up (N = 492), 89.8% provided data at either the age 26 or age 29 assessment (N = 442). Men who did not provide data at either follow-up (including those who died) did not differ from men who participated in at least one young adult interview on average alcohol frequency and marijuana frequency between ages 14-17. For this study, we focused on the age 26 and age 29 assessments because the coping scales from the Cooper (1994) Drinking Motivation Questionnaire Revised (DMQ-R) and the Simons et al. (1998) MMM were only available at those two time points. At each age only alcohol and/or marijuana users were included in the analysis.

In adulthood, most interviews were conducted in-person using a laptop computer and written consent was obtained from the men. All study procedures were approved by the University of Pittsburgh Institutional Review Board.

### *Measures*

*Substance Use.* Participants reported the number of times (continuous scale from 0 to 365) they used alcohol and marijuana in the last year at age 26 and at age 29. Alcohol users were also asked the typical quantity they consumed on days when they drank (5-point scale from 1 = less than one drink to 5 = six plus drinks). Nonusers were coded as 0. Means and standard deviations for all measures are shown in Table 1.

*Coping Motives.* The men completed the coping scales from the DMQ-R (Cooper, 1994) and MMM (Simons et al., 1998). These scales ask how often (5-point scale: 1 = almost never/never, 2 = some of the time, 3 = half of the time, 4 = most of

the time, 5 = almost always/always) participants used a substance for a particular reason when they used that substance in the past year. The same five items were asked for alcohol and marijuana: “to forget your worries,” “because it helps when you feel depressed,” “to cheer you up when in a bad mood,” “to forget your problems,” and “to feel more self-confident and sure of yourself.” Cronbach alpha was .87 for alcohol coping at age 26 and .87 at age 29 and .87 for marijuana coping at age 26 and .82 at age 29.

*Stress.* Stress was measured with 13 items from the Perceived Stress Scale (Cohen & Williamson, 1988), which measures perceptions of stress level and ability to handle problems. Respondents reported on the frequency (5 point scale: 1 = never, 2 = almost never, 3 = sometimes, 4 = fairly often, and 5 = often) in the month prior to the assessment. Example items included: “upset because of something that happened unexpectedly,” “felt nervous and ‘stressed,’” “inability to cope with things you had to do,” and

“unable to control important things in your life.” In this sample, the alpha was .86 at age 26 and .87 at age 29.

*Control Variables.* Enhancement motives were controlled in the analysis because in some studies they have attenuated the association between coping motives and substance use (see Cooper et al., 2016). We could not control for social and conformity motives because they were not assessed in this study. Enhancement motives were assessed by the DMQ-R (Cooper, 1994) and MMM (Simons et al., 1998) using the same response options as for coping motives. The same five enhancement motives were asked for alcohol and marijuana: “I like the feeling,” “it’s exciting,” “to get high,” “it gives me a pleasant feeling,” and “it’s fun.” Chronbach alpha was .86 for alcohol enhancement at age 26 and age 29 and .82 for marijuana enhancement at age 26 and .80 at age 29.

**Table 1.** Correlations among Variables at Ages 26 (above the diagonal) and 29 (below the diagonal) and Sample Descriptive Statistics at Ages 26 and 29

	Stress	Acope	Falc	Qalc	Aenh	Mcope	Fmar	Menh
Stress	-	.37***	.04	-.07	.11*	.48***	.18***	.15
Acope	.40***	-	.26***	.22***	.40***	.61***	.13*	.13
Falc	.07	.28***	-	.46***	.34***	.15	.25***	.11
Qalc	.07	.28***	.41***	-	.46***	-.01	.18***	.09**
Aenh	.18**	.41***	.27***	.50***	-	.17*	.24***	.51***
Mcope	.44***	.62***	.02	.07	.17	-	.25**	.42***
Fmar	.12*	.11	.26***	.26***	.15**	.20*	-	.41***
Menh	.09	.05	.07	.08	.42***	.30***	.27**	-
Mean at 26	28.72	7.85	66.07	3.12	13.04	10.13	60.0	17.40
SD at 26	7.21	3.52	79.68	1.76	4.92	4.90	121.76	4.78
(N) at 26	(425)	(344)	(425)	(425)	(344)	(159)	(425)	(159)
Mean at 29	29.95	7.83	62.27	3.11	12.78	9.12	58.11	17.34
SD at 29	7.89	3.65	79.78	1.65	4.85	4.10	116.60	4.80
(N) at 29	(399)	(332)	(400)	(399)	(332)	(138)	(400)	(138)

*Note.* Acope = alcohol coping motives; Falc = frequency of alcohol use; Qalc = quantity of alcohol use; Aenh = alcohol enhancement motives; Mcope = marijuana coping motives; Fmar = frequency of marijuana; Menh = marijuana enhancement motives; SD = standard deviation; (N) = Sample size for that variable. \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

We also controlled for race in the analyses due to race differences in substance use (White, Loeber, & Chung, 2016). In this sample, black, compared to white, men reported significantly higher alcohol frequency at age 26 ( $t = 2.83$ ,  $df = 326$ ,  $p < .01$ ), higher marijuana frequency at age 26 ( $t = 3.99$ ,  $df = 149$ ,  $p < .001$ ) and age 29 ( $t = 2.84$ ,  $df = 130$ ,  $p < .01$ ), and lower alcohol quantity at age 26 ( $t = -3.60$ ,  $df = 326$ ,  $p < .001$ ). Race was included as two dummy variables, white and other, with black as the reference group

### *Analytic Plan*

First, we examined correlations among the variables separately at age 26 and age 29. Next, we tested hierarchical OLS regression models. The first model regressed substance use on coping motives and level of perceived stress. The second model added enhancement motives to the first model. The third model added the interaction term between stress and coping to the second model. All independent variables were standardized. These models were conducted separately for alcohol and marijuana outcomes cross-sectionally at age 26 ( $N = 344$  and  $N = 159$ , respectively) and age 29 ( $N = 332$  and  $N = 138$ , respectively), controlling for race. In addition, longitudinal models were tested by including age 26 stress and motives to predict age 29 substance use outcomes ( $N = 317$  for alcohol and  $N = 149$  for marijuana), while controlling for age 26 substance use as well as race. Analyses were run examining the association of alcohol coping with alcohol frequency and quantity and marijuana frequency as well as the association of marijuana coping with these three outcomes. Because we examined three outcomes (alcohol frequency, alcohol quantity, and marijuana frequency) at three time frames (age 26, age 29, and from age 26 to age 29), a Bonferroni correction was applied ( $p < .0056$ ).

## RESULTS

### *Descriptive Analyses*

Table 1 shows the correlations among each of the measures and their means and standard deviations. At both ages, there was a strong association between alcohol coping motives and marijuana coping motives. In addition, at both ages, stress was strongly associated with both

alcohol and marijuana coping. At age 26 and age 29, alcohol coping motives were modestly associated with alcohol frequency and quantity, and marijuana coping motives were modestly associated with marijuana frequency. Alcohol and marijuana enhancement motives were strongly correlated with each other as well as moderately correlated with their substance-specific coping motives.

### *Substance-Specific Analyses*

Table 2 shows the results from the main effects models examining the associations between alcohol coping and alcohol outcomes and between marijuana coping and marijuana outcomes. None of the interactions of coping motives and stress was significant; thus, the results from these models are not included in the table (but are available from the first author upon request).

Without substance-specific enhancement motives in the model (Model 1), stronger alcohol coping motives were significantly related to higher alcohol frequency and quantity at both ages. Stress was not significantly related to alcohol frequency at either age. Higher stress was related to higher alcohol quantity at age 29 but not at age 26. With controls for age 26 alcohol frequency, alcohol coping motives and stress at age 26 did not significantly predict alcohol frequency at age 29. With controls for age 26 alcohol quantity, neither alcohol coping nor stress at age 26 significantly predicted age 29 alcohol quantity.

In Model 1, coping motives for marijuana use were concurrently related to marijuana frequency at age 26 but not age 29. Stress was not significantly related to marijuana frequency at either age. With controls for age 26 marijuana frequency, neither marijuana coping motives at age 26 nor stress at age 26 significantly predicted marijuana frequency at age 29. When substance-specific enhancement motives were added to the models (Model 2), the association between alcohol coping and alcohol frequency remained significant at age 29 but not at age 26 and the association between alcohol coping and alcohol quantity lost significance at both ages. Stress at age 29 remained a significant predictor of alcohol quantity at age 29. Alcohol

**Table 2.** Results from Main Effects<sup>a</sup> Models for Substance-specific Analyses, with and without Enhancement Motives<sup>b</sup>

Alcohol Frequency			Alcohol Quantity			Marijuana Frequency		
At Age 26 (N=344)	Model 1 B (SE)	Model 2 B (SE)	At Age 26 (N=344)	Model 1 B (SE)	Model 2 B (SE)	At Age 26 (N=159)	Model 1 B (SE)	Model 2 B (SE)
Alcohol Coping	21.18*** (4.56)	11.62 (4.78)	Alcohol Coping	0.25*** (0.05)	0.06 (0.05)	Marijuana Coping	39.26** (13.08)	14.55 (13.49)
Stress	-0.99 (4.62)	.15 (4.46)	Stress	-0.01 (0.06)	0.01 (0.05)	Stress	-9.68 (12.08)	-5.30 (11.42)
Alcohol Enhancement		22.62*** (4.44)	Alcohol Enhancement		0.44*** (0.05)	Marijuana Enhancement		53.77*** (11.91)
<i>R</i> <sup>2</sup>	.09***	.15***	<i>R</i> <sup>2</sup>	.11***	.27***	<i>R</i> <sup>2</sup>	.15***	.25***
At Age 29 (N=331)			At Age 29 (N=331)			At Age 29 (N=138)		
Alcohol Coping	22.65*** (4.74)	16.59** (5.04)	Alcohol Coping	0.21*** (0.05)	0.03 (0.05)	Marijuana Coping	30.03 (13.48)	18.44 (13.77)
Stress	-2.38 (4.79)	-2.65 (4.73)	Stress	0.19*** (0.06)	0.18*** (0.05)	Stress	-20.44 (14.26)	-18.73 (13.91)
Alcohol Enhancement		14.93** (4.68)	Alcohol Enhancement		.44*** (.05)	Marijuana Enhancement		34.45** (12.20)
<i>R</i> <sup>2</sup>	.09***	.12***	<i>R</i> <sup>2</sup>	.12***	.30***	<i>R</i> <sup>2</sup>	.10	.15***
Age 26 to 29 (N=317)			Age 26 to 29 (N=316)			Age 26 to 29 (N=149)		
Alcohol Coping	0.88 (4.56)	-0.25 (4.83)	Alcohol Coping	-0.07 (0.08)	-0.12 (0.08)	Marijuana Coping	-8.55 (13.23)	-13.42 (14.15)
Stress	-2.21 (4.50)	-2.12 (4.50)	Stress	0.15 (0.08)	0.16 (0.08)	Stress	11.01 (11.86)	12.03 (11.90)
Alcohol Frequency	39.65*** (4.16)	38.82*** (4.32)	Alcohol Quantity	0.51*** (0.08)	0.45*** (0.08)	Marijuana Frequency	42.10*** (9.80)	38.64*** (10.43)
Alcohol Enhancement		3.31 (4.64)	Alcohol Enhancement		0.15 (0.09)	Marijuana Enhancement		13.05 (13.42)
<i>R</i> <sup>2</sup>	.25***	.25***	<i>R</i> <sup>2</sup>	.14***	.15***	<i>R</i> <sup>2</sup>	.15***	.15***

*Note.* <sup>a</sup> Only main effects models are shown because none of the interactions was significant. <sup>b</sup> Race was controlled in all models and was coded as two dummy variables (white and other) with black as the reference group; results for race are not shown to simplify the presentation. \*\* $p < .0056$ ; \*\*\* $p < .001$ .

enhancement motives were significantly related to alcohol frequency and quantity at both ages. After controlling for age 26 alcohol use, coping and enhancement motives and stress at age 26 were not significant predictors of alcohol frequency or quantity at age 29.

When substance-specific enhancement motives were added to the models (Model 2), the association between alcohol coping and alcohol frequency remained significant at age 29 but not at age 26 and the association between alcohol coping and alcohol quantity lost significance at both ages. Stress at age 29 remained a significant predictor of alcohol quantity at age 29. Alcohol enhancement motives were significantly related to alcohol frequency and quantity at both ages. After controlling for age 26 alcohol use, coping and enhancement motives and stress at age 26 were not significant predictors of alcohol frequency or quantity at age 29.

In Model 2, marijuana enhancement motives significantly predicted marijuana frequency at both ages, whereas marijuana coping motives and stress did not. With control for marijuana frequency at age 26, coping and enhancement motives and stress at age 26 were not significantly related to marijuana frequency at age 29.

### *Crossover Analyses*

Table 3 shows the same main effects models for crossover effects, that is, marijuana motives predicting alcohol use and alcohol motives predicting marijuana use. Again, none of the interactions was significant and, thus, these models are not shown (but are available from the first author).

At both ages marijuana coping was not related to alcohol frequency or quantity and alcohol coping was not significantly related to marijuana frequency, with and without control for enhancement motives (Model 2 and Model 1, respectively). In both Models 1 and 2, stress at age 26 was significantly related to marijuana frequency at age 26 but this association was not significant at age 29. Alcohol enhancement motives were significantly related to marijuana frequency at age 26 but not 29. In the longitudinal models marijuana coping was

negatively related to alcohol frequency but none of the other crossover effects was significant.

## DISCUSSION

Consistent with previous studies (for reviews see Cooper et al., 2016; Kuntsche et al., 2005), there were significant concurrent associations between alcohol coping motives and alcohol frequency and quantity. Marijuana coping motives were also significantly related to marijuana frequency at age 26 but not 29. These associations were not statistically significant when enhancement motives were included in the model (except for alcohol coping motives predicting alcohol frequency at age 29), and instead substance-specific enhancement motives were the strongest predictors of use outcomes in all cross-sectional analyses. Thus, it appears that frequent and heavy use, at least during the mid-to-late 20s, is more strongly related to enhancement motives than coping motives. In some ways this is not surprising given that coping motives have more consistently been associated with substance use-related problems than with use (Cooper et al., 2016). Future research should examine coping and enhancement motives as predictors of substance use problems. Unfortunately, we only obtained diagnostic information and base rates of substance use disorders were too low for analysis in the present study.

Despite strong bivariate associations between alcohol and marijuana coping motives at both ages, the cross-sectional crossover effects from alcohol coping motives to marijuana use and from marijuana coping motives to alcohol use were not significant. These findings are consistent with other studies of crossover effects of coping motives (e.g., Foster, Allan, Zvolensky, & Schmidt, 2015; Foster et al., 2016). Because alcohol and marijuana have different psychopharmacological effects, some people may prefer one drug over the other for relief from negative affect, and, thus, crossover effects for coping motives may not be strong. Similarly, there was only one crossover effect for enhancement motives, from alcohol enhancement to marijuana frequency at age 26. Perhaps during the peak years of use, those youths who use alcohol for fun and to get high may also be likely to use marijuana for these same reasons.



Table 3. Results from Main Effects<sup>a</sup> Models for Crossover Analyses, with and without Enhancement Motives<sup>b</sup>

Alcohol Frequency			Alcohol Quantity			Marijuana Frequency		
At Age 26 (N = 159)	Model 1 B (SE)	Model 2 B (SE)	At Age 26 (N = 159)	Model 1 B (SE)	Model 2 B (SE)	At Age 26 (N = 344)	Model 1 B (SE)	Model 2 B (SE)
Marijuana	13.79 (8.35)	11.33 (9.16)	Marijuana	0.05 (0.12)	-0.03 (0.13)	Alcohol	6.45 (7.08)	-5.88 (7.52)
Coping			Coping			Coping		
Stress	-1.23 (7.71)	-0.80 (7.75)	Stress	-0.07 (0.11)	-0.06 (0.11)	Stress	20.15** (7.17)	21.62** (7.01)
Marijuana Enhancement		5.36 (8.09)	Marijuana Enhancement		0.17 (0.12)	Alcohol Enhancement		29.19*** (6.98)
<i>R</i> <sup>2</sup>	.02	.03	<i>R</i> <sup>2</sup>	.06	.07	<i>R</i> <sup>2</sup>	.14***	.18***
At Age 29 (N = 138)			At Age 29 (N = 137)			At Age 29 (N = 331)		
Marijuana	-2.25 (9.24)	-4.79 (9.68)	Marijuana	-0.09 (0.11)	-0.14 (0.11)	Alcohol	6.38 (7.28)	0.13 (7.82)
Coping			Coping			Coping		
Stress	3.25 (9.77)	3.62 (9.79)	Stress	0.10 (0.11)	0.11 (0.11)	Stress	9.06 (7.37)	8.79 (7.33)
Marijuana Enhancement		7.53 (8.58)	Marijuana Enhancement		0.13 (0.10)	Alcohol Enhancement		15.39 (7.26)
<i>R</i> <sup>2</sup>	.01	.02	<i>R</i> <sup>2</sup>	.07	.08	<i>R</i> <sup>2</sup>	.06***	.08***
From Age 26 to 29 (N = 149)			From Age 26 to 29 (N = 138)			From Age 26 to 29 (N = 317)		
Marijuana	-22.36** (7.65)	-23.18** (8.39)	Marijuana	-0.23 (0.12)	-.024 (0.14)	Alcohol	-2.61 (6.22)	-7.69 (6.70)
Coping			Coping			Coping		
Stress	4.32 (6.99)	4.51 (7.05)	Stress	0.18 (0.11)	0.18 (0.12)	Stress	4.59 (6.39)	5.43 (6.37)
Alcohol Frequency	42.11*** (5.82)***	42.06*** (5.84)	Alcohol Quantity	0.37** (0.12)	0.36** (0.13)	Marijuana Frequency	51.34*** (5.82)	48.76*** (5.94)
Marijuana Enhancement		1.82 (7.48)	Marijuana Enhancement		0.03 (0.13)	Alcohol Enhancement		12.67 (6.40)
<i>R</i> <sup>2</sup>	.29***	.29***	<i>R</i> <sup>2</sup>	.10	.10	<i>R</i> <sup>2</sup>	.26***	.27***

Note. <sup>a</sup> Only main effects models are shown because none of the interactions was significant. <sup>b</sup> Race was controlled in all models and was coded as two dummy variables (white and other) with black as the reference group; results for race are not shown to simplify the presentation. \*\* $p < .0056$ ; \*\*\* $p < .001$ .

Stress was not related to frequency of use in the substance-specific analyses. This finding is in accord with previous research on alcohol use, which has failed to consistently find a significant association between stress and drinking outcomes, possibly due to differential measures of stress (Corbin, Farmer, & Koekesman, 2013; Thomas et al., 2014). The lack of a strong association between stress and use frequency in this study may also reflect a mediating effect of coping motives on the association between stress and use (see Corbin et al., 2013). That is, the association between stress and substance use may be indirect. We did not examine this possible mediation model due to our focus on a theoretically different question (i.e., whether stress exacerbates the effects of coping motives) and also due to an inability to ensure temporal order among variables in this design. Future longitudinal studies with more time frames of assessment should explore such mediating models where temporal precedence can be more clearly demonstrated.

Whereas, in the substance-specific analyses, stress was not related to alcohol or marijuana frequency, it was related to alcohol quantity at age 29. The fact that the stress-alcohol quantity association was significant at age 29 but not at age 26 may reflect developmental changes in drinking behavior. Drinking large quantities of alcohol is normative during emerging adulthood, but many youths mature out of heavy drinking as they approach young adulthood (White, Labouvie, & Papadaratsakis, 2005). Thus, it may be that higher stress may interfere with the normative maturation out of heavy drinking and that those individuals who experience the most stress drink heavily to alleviate it. Alternatively, the difference may reflect differential exposure or vulnerability to stress between ages 26 and 29.

This study was not without limitations. Although this study followed participants from childhood through young adulthood prospectively, we were limited to the age 26 and 29 assessments because those were the only two when a validated measure of coping motives was included. As such, it is unclear whether findings would extend to adolescents or to older adults. All measures were based on self-report, although this is common for substance use as well as coping motives and perceived stress. Also, as mentioned previously, we did not include a

measure of substance-related problems as an outcome. Furthermore, because we only assessed coping and enhancement motives, we could not control for social and conformity motives. The sample was limited to young adult men from one geographic area. Future research is needed to replicate these findings with women and individuals from varying locations.

Despite these limitations, the study had several strengths. It used validated measures of coping motives and perceived stress; it used a longitudinal design; and it examined both alcohol and marijuana substance-specific and crossover effects within a single study. The results demonstrate an association between substance-specific coping motives and heavier use of alcohol and marijuana, which was maintained through the late 20s for alcohol and through the middle 20s for marijuana. However, these associations were no longer significant when enhancement motives were controlled. Therefore, the results highlight the need for interventions to challenge both enhancement and coping motives throughout young adulthood.

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**Funding:** Manuscript preparation was supported by grants from the National Institute on Drug Abuse (R01DA034608; R01DA040880) and National Institute on Alcohol Abuse and Alcoholism (R01AA012171). Data collection was supported by grant awards from the National Institute on Drug Abuse (R01DA011018), National Institute of Mental Health (P30MH079920; R01MH048890; R01MH050778), the Office of Juvenile Justice and Delinquency Prevention (86-JN-CX-0009), Pew Charitable

Trusts, and the Pennsylvania State Department of Health (SAP 4100043365). Points of view in this document are those of the authors and do not necessarily represent the official position or policies of the U.S. Department of Justice or National Institutes of Health. The funding sources had no role in the analysis or interpretation of the data, the preparation of this manuscript, or the decision to submit the manuscript for publication.

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